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01 AERONAUTICS (GENERAL)

N76-32124*# Systems Research Labs., Inc., Newport News, Va.
THE EFFECT OF HELICOPTER MAIN ROTOR BLADE PHASING AND SPACING ON PERFORMANCE, BLADE LOADS, AND ACOUSTICS Final Report
Santu T. Gangwani Washington NASA Sep. 1976 100 p refs
(Contract NAS1-13705)
(NASA-CR-2737; SRL-3169-0014) Avail: NTIS HC$5.00 CSCL 01A

The performance, blade loads, and acoustic characteristics of a variable geometry rotor (VGR) system in forward flight and in a pullup maneuver were determined by the use of existing analytical programs. The investigation considered the independent effects of vertical separation of two three-bladed rotor systems as well as the effects of azimuthal spacing between the blades of the two rotors. The computations were done to determine the effects of these parameters on the performance, blade loads, and acoustic characteristics at two advance ratios in steady-state level flight and for two different g pullups at one advance ratio. To evaluate the potential benefits of the VGR concept in forward flight and pullup maneuvers, the results were compared as to performance, oscillatory blade loadings, vibratory forces transmitted to the fixed fuselage, and the rotor noise characteristics of the various VGR configurations with those of the conventional six-bladed rotor system. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N76-32125 New York Univ., N.Y.
THE TRANSONIC FLOW IN A NOZZLE Ph.D. Thesis
Wei W. Tseng 1976 102 p
Avail: Univ. Microfilms Order No. 76-19558

A family of channels as walls of the corresponding gas flows was constructed with a given constant subsonic speed at one end of the channel. This determines, for each channel in the family, a smooth flow which determines a supersonic constant speed of the flow near the other end of the channel. A family of boundary value problems was defined with the equation which is Tricomi's gas equation in the transonic and supersonic region and is the ideal gas equation in the subsonic region. The unique solution of the boundary value problems was then obtained and was shown to have the properties of a type of flow discussed by T. Meyer in a paper published in 1908. At the same time, the shape of the channel is obtained as the image of the boundary under the transformation. Dissert. Abstr.

N76-32126# Advisory Group for Aerospace Research and Development, Paris (France).
UNSTEADY PRESSURES DUE TO CONTROL SURFACE ROTATION AT LOW SUPERSONIC SPEEDS: COMPARISON BETWEEN THEORY AND EXPERIMENT
C. G. Lodge (British Aircraft Corp. Limited, Lanshire) and H. Schmid (Messerschmitt-Bolkow-Blohm GmbH, Munich) Sep. 1976 21 p refs Presented at the 42d Meeting of the Structures and Materials Panel, Ottawa, 5 Apr. 1976
(AGARD-R-647; ISBN-92-835-1223-5) Avail: NTIS

Most aircraft flutter problems have featured control surfaces, and it is necessary that unsteady aerodynamic forces generated by their motions should be accurately predicted. Therefore theoretical and experimental studies were conducted on a planform with part span control surface oscillating in the control surface rotation mode at low supersonic Mach numbers. The results are presented and discussed. It is shown that these studies must be of a high accuracy so that the more critical aerodynamic coefficients, such as hinge moment damping, are determined with confidence. Author

N76-32127*# Kansas Univ. Center for Research, Inc., Lawrence. Dept. of Aerospace Engineering.
AN INVESTIGATION OF DRAG REDUCTION ON BOX-SHAPED GROUND VEHICLES Final Report
Vincent U. Muirhead Jul. 1976 94 p refs
(Grant NsG-4004)
(NASA-CR-148829; KU-FRL-180) Avail: NTIS HC $5.00 CSCL 01A

A wind tunnel investigation was conducted to determine the reduction in drag which could be obtained by making various configuration changes to a box-shaped ground vehicle. Tests were conducted at yaw (relative wind) angles of 0, 5, 10, 20, and 30 degrees and Reynolds numbers of 300,000 to 850,000. The power required to overcome the aerodynamic drag was reduced by a maximum of 73% for a head wind for the best configuration relative to the smooth bottom box-shape, or 75% relative to the rough bottom box-shape. The reduction for a 20 MPH wind at 30 deg to the vehicle path was, respectively, 77% and 79%.
Author

N76-32128*# Transemantics, Inc., Washington, D.C.
EXPERIMENTAL AND THEORETICAL STUDY OF TWO-DIMENSIONAL TURBULENT INCOMPRESSIBLE REATTACHMENT
Jean-Claude LeBalleur and Jean Mirande Sep. 1976 46 p refs Transl. into ENGLISH of "Etude experimentale et theorique du recollement bidimensionnel turbulent incompressible", NATA AGARD, AGARD-CP-168, 1975 pp 17-1 - 17-13 Published in Proceedings of the Fluid Dynamics Panel Symp., Goettingen, Germany, 27-30 May 1975
(Contract NASw-2792)
(NASA-TT-F-17186) Avail: NTIS HC $4.00 CSCL 01A

Turbulent reattaching flow downstream of a backward facing step was experimented using a two dimensional plane in-

compressible configuration, with possibility to induce favorable or adverse pressure gradients in the potential flow near attachment. Detailed pressure and velocity measurements in this region made it possible to suggest general empirical rules whose efficiency relies on a thin initial separating boundary layer. A whole calculation was performed by obtaining a self induced interaction in matching a wall dissipative layer with an inviscid and irrotational external flow. Except for weak viscous interaction regions, an inverse calculation process was used to avoid singularities following the Klinerberg's method for transonic aerofoils. Wall pressure distribution then results of an integral boundary layer calculation, whose failure for strongly separated regions is easily overcome by substitution of an empirical pressure law. Author

N76-32129*# Tennessee Univ., Knoxville.
EVALUATION OF TWO SWEPT-INFINITE-WING POTENTIAL/VISCOUS-FLOW COMPUTER PROGRAMS
Rao V. Arimilli Aug. 1976 23 p refs Sponsored by NASA
(NASA-CR-145037) Avail: NTIS HC $3.50 CSCL 01A

Two computer programs capable of predicting the potential and viscous interacting flow around wings of infinite aspect ratio was evaluated. The programs are compared in terms of their capabilities, the approximations and the methods of solution used, and the input requirements. Six airfoils, each representative of a class of airfoils, are used as test airfoils. The results predicted by the programs are presented for each airfoil at sweep angles of 0, 20, and 40 degrees over a range of angles of attack. The results show that at zero sweep both programs predicted the aerodynamic coefficients well and generally in good agreement with measurements. At 20 and 40 degrees of sweep, as there are no experimental data available, definitive conclusions cannot be drawn about the accuracy of the predictions although the results are presented and discussed. The execution times are approximately the same for the two programs. Author

N76-32130*# Washington Univ., Seattle. Dept. of Mechanical Engineering.
TURBULENCE MEASUREMENTS IN AXISYMMETRIC SUPERSONIC BOUNDARY LAYER FLOW IN ADVERSE PRESSURE GRADIENTS
Edward Gootzait and Morris E. Childs 1976 22 p refs
(Grant NGR-48-002-047)
(NASA-CR-148807) Avail: NTIS HC $3.50 CSCL 01A

Measurements have been made of the mean-flow and turbulence properties in adiabatic turbulent boundary layer flows subjected to adverse pressure gradients. In the freestream region upstream of the adverse pressure gradient the Mach number was 3.86, the unit Reynolds number 5.3 million per foot. The boundary layer developed on the wall of an axisymmetric nozzle and straight test section. The pressure gradients at the test section wall were induced by contoured centerbodies mounted on the wind tunnel centerline. The flow under study simulated that which might be found in an axially symmetric engine inlet of a supersonic aircraft. The results obtained have shown good agreement to exist between the measured normalized turbulent velocity fluctuations and the results from other recent investigations of compressible boundary layers. Author

N76-32131*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
A COMPUTER PROGRAM TO CALCULATE THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF WING-FLAP CONFIGURATIONS WITH EXTERNALLY BLOWN FLAPS Final Report
Michael R. Mendenhall, Frederick K. Goodwin, and Selden B. Spangler Washington NASA Sep. 1976 91 p refs
(Contract NAS1-13158)
(NASA-CR-2706) Avail: NTIS HC $5.00 CSCL 01A

A vortex lattice lifting-surface method is used to model the wing and multiple flaps. Each lifting surface may be of arbitrary planform having camber and twist, and the multiple-slotted trailing-edge flap system may consist of up to ten flaps with different spans and deflection angles. The engine wakes model consists of a series of closely spaced vortex rings with circular or elliptic cross sections. The rings are normal to a wake centerline which is free to move vertically and laterally to accommodate the local flow field beneath the wing and flaps. The two potential flow models are used in an iterative fashion to calculate the wing-flap loading distribution including the influence of the waves from up to two turbofan engines on the semispan. The method is limited to the condition where the flow and geometry of the configurations are symmetric about the vertical plane containing the wing root chord. The calculation procedure starts with arbitrarily positioned wake centerlines and the iterative calculation continues until the total configuration loading converges within a prescribed tolerance. Program results include total configuration forces and moments, individual lifting-surface load distributions, including pressure distributions, individual flap hinge moments, and flow field calculation at arbitrary field points. Author

N76-32132*# Boeing Commercial Airplane Co., Seattle, Wash.
TRANSONIC PRESSURE MEASUREMENTS AND COMPARISON OF THEORY TO EXPERIMENT FOR AN ARROW-WING CONFIGURATION
Marjorie E. Manro, Kenneth J. R. Manning, Thomas H. Hallstaff, and John T. Rogers Aug. 1976 491 p refs
(Contract NAS1-12875)
(NASA-CR-2610; D6-42670-1; FAA-RD-76-72) Avail: NTIS HC $12.50 CSCL 01A

A wind tunnel test of an arrow-wing-body configuration consisting of flat and twisted wings as well as a variety of leading- and trailing-edge control surface deflections, was conducted at Mach numbers from 0.4 to 1.1 to provide an experimental pressure data base for comparison with theoretical methods. Theory-to-experiment comparisons of detailed pressure distributions were made using current state-of-the-art attached and separated flow methods. The purpose of these comparisons was to delineate conditions under which these theories are valid for both flat and twisted wings and to explore the use of empirical methods to correct the theoretical methods where theory is deficient. The results are summarized. Author

N76-32133*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF BLOWING OVER VARIOUS TRAILING-EDGE FLAPS ON AN NACA 0006 AIRFOIL SECTION, COMPARISONS WITH VARIOUS TYPES OF FLAPS ON OTHER AIRFOIL SECTIONS, AND AN ANALYSIS OF FLOW AND POWER RELATIONSHIPS FOR BLOWING SYSTEMS
Jules B. Dods, Jr. and Earl C. Watson Aug. 1976 145 p refs Supersedes NACA-RM-A56C01
(NASA-TN-D-8293; A-6423; NACA-RM-A56C01) Avail: NTIS HC $6.00 CSCL 01A

The results are presented of a two-dimensional investigation conducted to determine the effect of blowing over various types of trailing-edge flaps on a wing having the NACA 0006 airfoil section and a drooped-nose flap. The position and profile of the trailing-edge flap, the nozzle height, and the location of the flap with respect to the nozzle were found to be important variables. Data from many investigations were used to make an evaluation of the effects of blowing on lift. An analysis was made of flow and power relationships for blowing systems. Author

N76-32134*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF AN ISOLATED TWO-DIMENSIONAL WEDGE NOZZLE WITH FIXED COWL AND VARIABLE WEDGE CENTERBODY AT MACH NUMBERS UP TO 2.01
Donald L. Maiden Washington Sep. 1976 126 p refs
(NASA-TN-D-8218; L-10611) Avail: NTIS HC $6.00 CSCL 01A

A wind tunnel investigation has been conducted to determine the aeropropulsion performance (thrust minus drag) of an isolated, two-dimensional wedge nozzle with a simulated variable-wedge mechanism and a fixed cowl. The investigation was conducted statically and at Mach numbers from 0.60 to 1.20 in the Langley 16-foot transonic tunnel and at a Mach number of 2.01 in the Langley 4-foot supersonic pressure tunnel. The ratio of exhaust jet total pressure to free-stream static pressure was varied up to 27 depending on free-stream Mach number. The results indicate that the aeropropulsion performance of the two-dimensional fixed-cowl variable-wedge nozzle is slightly lower (0.7 to 1.4 percent of ideal thrust) than that achieved for a two-dimensional wedge nozzle with a translating shroud, although part of the

difference in performance is attributed to internal-performance differences. The effects of cowl boattail angle, internal expansion area ratio, and wedge half-angle on the performance of the two-dimensional wedge nozzle are discussed. Author

N76-32135# California Univ., Davis.
MAGNUS FORCES ON SPINNING SUPERSONIC CONES. PART 1: THE INVISCID FLOW Final Report
B. R. Sanders and H. A. Dwyer Mar. 1976 47 p refs
(Contract DAAD05-73-C-0039; DA Proj. 1T1-61102-A-33H)
(AD-A022670; BRL-CR-292) Avail: NTIS CSCL 20/4

The numerical solution of steady, three-dimensional, inviscid, supersonic flows is applied to the calculation of Magnus forces on spinning cones at angle of attack. The Magnus force is made up of several contributions; the contribution due to the asymmetrical boundary-layer displacement-thickness interaction with the inviscid flow field is considered here. Three-dimensional, laminar boundary-layer solutions for the spinning cone were obtained by methods described in Part I of this paper. The displacement-thickness contribution to the Magnus force is calculated by solving the complete inviscid flow field over body shapes obtained by adding the three-dimensional displacement thickness to the cone radius. The gas dynamic equations are solved by applying MacCormack's second-order shock-capturing finite-difference technique. Special precautions had to be taken in both finite differencing and in applying the surface boundary conditions to maintain enough significant digits in the pressure calculation, since the Magnus force is as small as one part in three hundred of the normal force for some cases considered. The displacement-thickness contribution to the Magnus force, along with three other contributions described in Part I of this paper, are summarized here in Part II. The considerable cancellation effect observed among the four contributions shows that all of the components must be included if accurate predictions of the Magnus force are to be obtained. Author (GRA)

N76-32136# Aeronautical Research Associates of Princeton, Inc., N.J.
STATISTICAL MECHANICAL FOUNDATIONS OF AERODYNAMICS Final Report, 1 Jan. - 31 Dec. 1975
Guido Sandri Feb. 1976 10 p
(Contract F44620-75-C-0028; AF Proj. 9781)
(AD-A022843; ARAP-TM-76-1; AFOSR-76-0292TR) Avail: NTIS CSCL 07/4

Intuitively, the molecular collisions that contribute to transport when attempting to improve the Boltzmann approximation are the genuine or close three-body collisions (i.e., those that occur with separation less than the mean free path) rather than the remote collisions (i.e., all the others). The separation between close and remote collisions is an approximate consequence of the Volterra-Fredholm equation satisfied by the two-body correlation in the presence of all three-body collisions. GRA

N76-32137# Nielsen Engineering and Research, Inc., Mountain View, Calif.
AN INVESTIGATION OF SLENDER-BODY WAKE VORTICES Final Report, 20 Oct. 1975 - 20 Apr. 1976
John E. Fidler, Richard G. Schwind, and Jack N. Nielsen Feb. 1976 53 p refs
(Contract DAAH01-75-C-0008)
(AD-A023284; NEAR-TR-108) Avail: NTIS CSCL 20/4

The results of an investigation into the structure of slender missile body wake vortices are described. Symmetric and asymmetric vortex patterns are considered. Laser doppler velocimeter probing of the flow field produced data from which vortex strengths, positions, and induced velocities were determined. These were then compared with predictions of various theories. It was concluded that considerable upgrading of theory will be necessary before adequate engineering models of vortices become available. GRA

N76-32138# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
VISCOUS TRANSONIC AERODYNAMICS Final Report, 1 Jul. 1974 - 15 Sep. 1975
Donald Coles and Donald Collins 3 Mar. 1976 15 p refs
(Contract F44620-75-C-0007; AF Proj. 9781; AF Proj. 6813)
(AD-A023291; AFOSR-76-0433TR) Avail: NTIS CSCL 20/4

During the contract period, activity included verification of flow quality, calibration of a friction balance, and development of laser-Doppler instrumentation. Experiments carried out after the end of the contract period, but before the closing of the JPL 20-inch supersonic tunnel in February 1976, are mentioned briefly. GRA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N76-32139# Committee on Government Operations (U. S. House).
TRANSPORTATION OF HAZARDOUS MATERIALS BY AIR
Washington GPO 1976 96 p refs Hearing before a subcomm. of the Comm. on Govt. Operations, 94th Congr., 1st Sess., 8 Oct. 1975
(GPO-62-325) Avail: Comm. on Govt. Operations

Legislation enacted to protect the Nation adequately against the risks to life and property which are inherent in the transportation of hazardous materials in commerce is discussed. Emphasis is placed on transportation of hazardous materials by air. J.M.S.

N76-32140* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AIRCRAFT-MOUNTED CRASH-ACTIVATED TRANSMITTER DEVICE Patent
Robert Manoli (Rockwell Intern. Corp., Downey, Calif.) and Bertram R. Ulrich, inventors (to NASA) (Rockwell Intern. Corp., Downey Calif.) Issued 31 Aug. 1976 7 p Filed 3 Oct. 1974 Supersedes N74-34647 (12 - 24, p 2922) Continuation-in-part of abandoned US Patent Appl. SN-307714, filed 17 Nov. 1972, which is a continuation-in-part of abandoned US Patent Appl. SN-82279, filed 20 Oct. 1970
(NASA-Case-MFS-16609-3; US-Patent-3,978,410; US-Patent-Appl-SN-511894; US-Patent-Class-325-114; US-Patent-Class-325-115; US-Patent-Class-325-186; US-Patent-Class-343-705; US-Patent-Appl-SN-307714; US-Patent-Appl-SN-82279) Avail: US Patent Office CSCL 17C

An aircraft crash location transmitter tuned to transmit on standard emergency frequencies is reported that is shock mounted in a sealed circular case atop the tail of an aircraft by means of a shear pin designed to fail under a G loading associated with a crash situation. The antenna for the transmitter is a metallic spring blade coiled like a spiral spring around the outside of the circular case. A battery within the case for powering the transmitter is kept trickle charged from the electrical system of the aircraft through a break away connector on the case. When a crash occurs, the resultant ejection of the case from the tail due to a failure of the shear pin releases the free end of the antenna which automatically uncoils. The accompanying separation of the connector effects closing of the transmitter key and results in commencement of transmission.
Official Gazette of the U.S. Patent Office

N76-32141*# Stanford Research Inst., Menlo Park, Calif.
THE RESPONSE OF SMOKE DETECTORS TO PYROLYSIS AND COMBUSTION PRODUCTS FROM AIRCRAFT INTERIOR MATERIALS Final Report
Robert G. McKee and Norman J. Alvares 16 Apr. 1976 55 p refs
(Contract NAS2-8583; SRI Proj. PYU-3830)
(NASA-CR-137949) Avail: NTIS HC $4.50 CSCL 14B

The following projects were completed as part of the effort to develop and test economically feasible fire-resistant materials for interior furnishings of aircraft as well as detectors of incipient fires in passenger and cargo compartments: (1) determination of the sensitivity of various contemporary gas and smoke detectors to pyrolysis and combustion products from materials commonly used in aircraft interiors and from materials that may be used

in the future, (2) assessment of the environmental limitations to detector sensitivity and reliability. The tests were conducted on three groups of materials by exposure to the following three sources of exposure: radiant and Meeker burner flame, heated coil, and radiant source only. The first test series used radiant heat and flame exposures on easily obtainable test materials. Next, four materials were selected from the first group and exposed to an incandescent coil to provide the conditions for smoldering combustion. Finally, radiant heat exposures were used on advanced materials that are not readily available. Y.J.A.

N76-32142# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ANALYSIS OF SHOCK-ABSORBING CONCEPTS FOR BIRD-PROOF WINDSHIELDS OF ADVANCED AIR FORCE VEHICLES Final Report, Apr. 1972 - Nov. 1974
Werner R. Jansen Feb. 1976 284 p refs
(AF Proj. 1368)
(AD-A023621; AFFDL-TR-74-155) Avail: NTIS CSCL 01/2

Shock-absorbing windshields and mounting frames are required in advanced AF aircraft to permit mission continuance after a hit by a bird in low level, high speed flight. Analytical structural models of bird strike-proof, high visibility window systems are optimized using existing glazing materials, designs for realistic environmental conditions, and the influencing factors of proposed shock absorbing mechanisms. Theoretical results generated are compared with published experimental data. Parametric studies of structural response due to impact loading and damping of dynamic stresses due to energy absorption were performed to provide preliminary design data for windscreen protection against bird strike. Author (GRA)

N76-32143# Dayton Univ. Research Inst., Ohio. Research Inst.
BIRD IMPACT FORCES IN AIRCRAFT WINDSHIELD DESIGN Final Report, Jan. - Jun. 1975
Richard L. Peterson and John P. Barber Wright-Patterson AFB, Ohio AFFDL Mar. 1976 65 p refs
(Contract F33615-73-C-5027; AF Proj. 2202; AF Proj. 5027)
(AD-A023628; AFFDL-TR-75-150) Avail: NTIS CSCL 01/2

In order to design transparent aircraft windshield and canopy panels which can withstand the impact of birds, and at the same time meet other equally important operational requirements, it is necessary to define the forces generated during the birdstrike event. The total force as a function of time was measured by impacting birds onto a large diameter Hopkinson bar. The local pressures and pressure distribution during the bird impact were measured by flush mounting piezo-electric pressure transducers in a heavy rigid flat plate and impacting the plate/transducer assembly. The forces and pressures are a function of the relative impact velocity and angle, the weight and average density of the bird and the stiffness of the impacted structure. In order to define the temporal and spatial distribution of the bird impact forces, a parametric bird/plate impact test program was initiated. These tests cover a velocity range from 30 m/s to 350 m/s, impact angles from 15 to 90 deg in trajectory and bird weights from 0.05 kg to 3.6 kg. The results at the 90 deg test angle indicate that: (1) Birds behave essentially as a fluid during impact; (2) Birds do not bounce at impact -- the impulse is equal to the initial impact momentum; (3) The high-frequency component of pressure superimposed on the base pressure-time pulse is caused by breakup of the bird flesh and inhomogeneities in the bird; and (4) The duration of loading is approximately equal to the 'squash up' time. GRA

N76-32144# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA. US GENERAL AVIATION CALENDAR YEAR 1974
31 Jan. 1976 198 p
(PB-252606/9; NTSB-ARG-76-1) Avail: NTIS HC $7.50 CSCL 01B

The Annual Review of Aircraft Accident Data is a statistical compilation published by the National Transportation Safety Board. The publication contains statistical information compiled from reports of 4425 general aviation accidents that occurred during the calendar year 1974. Included in the total number of accidents are 59 collisions between aircraft. By coding each aircraft involved in the collisions, an additional 59 records are produced, bringing the total accidents records to 4484. This figure reflects the true number of pilots and aircraft involved in the accidents. Author (GRA)

N76-32344 Virginia Polytechnic Inst. and State Univ., Blacksburg.
CRASH SIMULATION
M. P. Kamat *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 73-82 refs (For availability see N76-32339 23-31)

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N76-32145 California Univ., Los Angeles.
ADVANCES IN RADIO NAVIGATION Ph.D. Thesis
Charles Henry Ebert, III 1976 83 p
Avail: Univ. Microfilms Order No. 76-20197

The problem of increasing the initial allowable region of uncertainty for radio navigation systems is considered. A method is proposed which makes use of a moving receiver. Such a receiver collects phase change data over time and then uses the pattern generated to deduce where the receiver is. The problem of finding where this received pattern could have occurred is solved using the method of steepest descent applied to a nonlinear least squares cost function. An analysis of the performance of this method in a noisy environment is made. A Chi-Square distribution is used to develop an approximation to the radial error distribution. This approximation is shown to give very good agreement with simulated results. Applications to Omega and other systems are considered. Dissert. Abstr.

N76-32146*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE DESIGN, DEVELOPMENT, AND FLIGHT TEST RESULTS OF THE BOEING 737 AIRCRAFT ANTENNAS FOR THE ICAO DEMONSTRATION OF THE TRSB MICROWAVE LANDING SYSTEM
Thomas G. Campbell, William E. White, and Melvin C. Gilreath 17 Aug. 1976 96 p refs
(NASA-TM-X-73943) Avail: NTIS HC $5.00 CSCL 17G

The Research Support Flight System, a modified Boeing 737, was used to evaluate the performance of several aircraft antennas and locations for the Time Reference Scanning Beam (TRSB) Microwave Landing System (MLS). These tests were conducted at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey on December 18, 1975. The flight tests measured the signal strength and all pertinent MLS data during a straight-in approach, a racetrack approach, and ICAO approach profiles using the independent antenna-receiver combinations simultaneously on the aircraft. Signal drop-outs were experienced during the various approaches but only a small percentage could be attributed to antenna pattern effects. Author

N76-32147# Mitre Corp., McLean, Va.
MULTI-SITE INTERMITTENT POSITIVE CONTROL ALGORITHMS FOR THE DISCRETE ADDRESS BEACON SYSTEM
A. L. McFarland, K. R. Patel, and D. L. Roberts May 1976 266 p refs
(Contract DOT-FA70WA-2448)
(AD-A026515/7; MTR-6742-Rev-2; FAA-EM-74-4-Change-2) Avail: NTIS HC $7.75 CSCL 17/7

Complete detailed computer algorithms for implementing intermittent positive control (IPC) within a multi site discrete address beacon system (DABS) network were presented. Author

N76-32148# Advisory Group for Aerospace Research and Development, Paris (France).
MEDIUM ACCURACY LOW COST NAVIGATION
Aug. 1976 387 p refs Presented at the AGARD Avionics Panel Tech. Meeting, Sandefjord, Norway, 8-12 Sep. 1975 (AGARD-CP-176) Avail: NTIS HC $10.75

A total of 29 papers were presented dealing with medium accuracy low cost navigation systems for aircraft and other vehicles, by considering all the options available, so as to determine, if possible, the optimum cost/accuracy mix. These papers were divided into the following five areas: requirements and specifications, radio techniques, non-radio techniques, appropriate navigation system components, and total system considerations. For individual titles, see N76-32149 through N76-32176. Author

N76-32149 Advisory Group for Aerospace Research and Development, Paris (France).
HIGHLIGHTS OF KEY CHARACTERISTICS CONSIDERED FUNDAMENTAL TO ANY NAVIGATION SYSTEM THAT MIGHT BE INTRODUCED INTO BRITISH ARMY AIRCRAFT
A. C. D. Watts (Brit. Army Air Corps) *In its* Medium Accuracy Low Cost Navigation Aug. 1976 5 p (For availability see N76-32148 23-04)

Operational factors influencing the requirement for army battlefield helicopter navigation systems are discussed and the needs of the operating crew are outlined. These considerations lead to the conclusion that a low cost, light weight, accurate, self-contained navigation system is required. Author

N76-32150 Royal Navy, London (England).
A SURVEY OF LOW COST SELF CONTAINED NAVIGATION SYSTEMS AND THEIR ACCURACIES
J. A. Tayler *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 5 p (For availability see N76-32148 23-04)

A definition of medium accuracy and low cost is first attempted, and it is noted that air-data systems do not achieve medium accuracy and inertial systems do not yet fall within the definition of low cost. Some simple truths about self contained systems are highlighted. The level of assurance at which navigation accuracies are quoted should be standardized. Doppler/compass accuracy is dictated by heading accuracy overland and by surface effects over water. The basic navigation information required by the pilot is whether he should steer left or right. Investigation is required on how best to integrate navigation systems with low light sensors. Author

N76-32151 Ferranti Ltd., Edinburgh (Scotland).
THE CONCEPTION OF LOW COST NAVIGATION SYSTEMS: ART OR SCIENCE?
W. H. McKinlay *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 7 p (For availability see N76-32148 23-04)

Some of the factors involved in arriving at the requirement for low cost navigation systems were pointed out. It turns out that while improvements in technology tend to reduce the costs of conventional systems, a true low cost system is probably one which is capable of extending the facilities offered by it to applications in which earlier solutions would have been declared uneconomic. The initial adoption of many of today's navigation techniques has been a result of the pressures to apply a new technology. It is suggested that in the low cost area, the corresponding pressures exerted by the market are much more significant. Most of today's devices meet traditional requirements and there may be alternative solutions if the sources of information and the techniques available to handle them are related to the minimum requirements of the operator. The closest and fastest possible process of iteration between operator and system designer is necessary. Author

N76-32152 Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Navigation and Radio Div.
MEDIUM ACCURACY LOW COST NAVIGATION SYSTEMS FOR HELICOPTERS
T. J. Penfold *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 7 p (For availability see N76-32148 23-04)

All the factors leading to a choice of a future navigation system for military helicopters were examined. The examination considers the past, the basic requirements for the navigation system, the helicopter environment, service requirement, possible systems, cost and standardization. It is concluded that a Doppler/compass system could meet the requirements for a medium accuracy/low cost system but that the requirement needs further definition especially in the areas of operational requirement and costs. It is hoped that in the future some measure of standardization be achieved; such an aim will need to be recognised and receive the goodwill of all interested parties. Author

N76-32153 Hawker Siddeley Aviation Ltd., Brough (England).
SOME NAVIGATIONAL CONCEPTS FOR REMOTELY PILOTED VEHICLES
J. W. Lyons, J. D. Bannister, and J. G. Brown *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 15 p refs (For availability see N76-32148 23-04)

Methods by which the navigation function for Remotely Piloted Vehicles (RPVs) can be achieved without the need for complex specialized navigation equipment were discussed. The objective is to make use of equipment normally carried for RPV operation to supplement a simple dead reckoning navigation system. The additional processing is carried out at the control center where restrictions on equipment size and cost are not so prohibitive. Techniques varying from the use of the data link to provide range-bearing navigation to map matching using reconnaissance sensors or a forward looking sensor picture were discussed. Use can also be made of an on-board laser to provide range-to-terrain measurements which, when correlated with a computer stored map, enables the RPV position to be continuously updated. Results of simulation studies carried out to validate the techniques and provide an estimate of the accuracies are presented. Author

N76-32154 Rockwell International Corp., Anaheim, Calif.
MICRO-NAVIGATOR (MICRON)
Jerry A. Schwarz *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 14 p refs Sponsored by the AF (For availability see N76-32148 23-04)

The Micron strapdown inertial navigation system, developed to be a low cost medium accuracy (one nautical mile per hour radial position error CEP rate) navigation system for future aircraft/missiles requiring medium accuracy, was described. The heart of the Micron system is the micro-electrostatic gyro, which consists of a one centimeter diameter spherical rotor suspended electrostatically by eight capacitor plates. The rotor is untorqued, thus avoiding the accuracy degradation and reliability degradation from gyro torquing electronics. The gyro is used in a strapdown mechanization and utilizes a unique mass-unbalance modulation technique for obtaining whole angle readout over all attitude angles. Two brassboard Micron systems have been fabricated and tested. The test results indicate better performance than the one nautical mile/hr performance goal under all environments tested (laboratory, vibration, shock, cold soak, scorsby, van, and flight test). The prototype Micron system is currently being designed, and a full evaluation test program is planned. Author

N76-32155 Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
DIGITAL PHASE PROCESSING FOR LOW-COST OMEGA RECEIVERS
Duncan B. Cox, Jr., William H. Lee, William M. Stonestreet, and Edwin V. Harrington, Jr. (AFAL) *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 16 p refs (For availability see N76-32148 23-04)
(Contract F33615-72-C-1335)

The application of the serial digital phase filter (SDPF) to Omega receivers is explored. It is shown that the internal functions of an Omega receiver can be organized to take advantage of one or more SDPF's used in combination with an LSI microprocessor. The SDPF's can also be used to reduce the load on the microprocessor by reducing the bandwidth of the phase data being presented to it. The SDPF's can also accomplish demodulation and analog-to-digital conversion, thereby eliminating the need for special circuitry to perform these functions. Because of the reduction in date bandwidth, there is an increase in efficiency and productivity of the microprocessor. The processing efficiency of the entire receiver is then more closely maximized with respect to hardware and software cost. The design approach is applicable

to a bare-bones receiver, which would incorporate the most elementary and inexpensive micoprocessor or no microprocessor at all. Author

N76-32156 ITT Avionics, Nutley, N.J.
LOW COST NAVIGATION PROCESSING FOR LORAN-C AND OMEGA
James F. DeLorme and Arthur R. Tuppen *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 17 p (For availability see N76-32148 23-04)

A technology feasibility demonstration was performed to determine the impact of advances in MOS/LSI semiconductor developments on performance and cost of radio navigation equipment; in particular, Loran C performance amd cost objectives were demonstrated. This demonstration has clearly shown that the performance requirements for both austere and sophisticated users can be satisfied. Advancement in semiconductor technology has provided MOS/LSI and Schottky Bi-Polar/LSI chip sets, central processor units and compatible semiconductor memories, whose architecture is compatible with the requirements for navigation processing. This technology has been applied to a Loran C sensor processor and a low cost airborne Omega Navigator. The digital processing, micro-computer configuration, resultant performance and cost projections for Loran C applications are described. The results of the mechanization for these systems are used to configure a combined Loran C or Omega Navigator, including an assessment of performance parameters, physical characteristics and costs projections. Author

N76-32157 Naval Electronics Lab. Center, San Diego, Calif.
A NAVIGATION MONITOR FOR VLF SIGNALS
E. R. Swanson *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 7 p refs (For availability see N76-32148 23-04)

An overview of the need for and the design of a VLF navigation monitor is presented. Fundamental associated with various VLF navigational techniques are discussed briefly; 2-mile accuracy or better is assumed typical. Safe operation within existing airways is normally possible, but protection against propagationally induced blunders should be provided by a navigation monitor. The monitor can be designed so as to provide not only disturbance warning but also disturbance prediction. The monitor can also assist in preflight. Author

N76-32158 Standard Electrik Lorenz A.G., Stuttgart (West Germany).
SOME CONSIDERATIONS ON POSSIBLE NEW VHF LOW COST RADIO NAVIGATION AIDS
M. Boehm *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 16 p refs (For availability see N76-32148 23-04)

New possibilities for low cost navigation aids for use in allocated VHF communication frequency bands are described. Conventional VHF radio sets are to be useable also for navigation by adding a simple attachment. Three system proposals are presented: (1) The ship navigation system SNS is to use shore stations employing either amplitude or frequency modulation. It would provide 0.1 deg error azimuth within a sector of e.g. 10 deg and 3.5 deg error omnirange azimuth. (2) The ship identification and location system SILOS is to employ a chain of shore based VHF DF stations which determine positions of ships by biangulating their communications transmissions. (3) The hyperbolic navigation system HNS for tactical applications is to use a chain of VHF stations transmitting synchronized modulation frequencies used for navigation. The coordinates of the highly mobile stations can be transmitted to the users continously in a coded form. Expected accuracy is 50 m CEP. Author

N76-32159 Messerschmidt-Boelkow G.m.b.H., Munich (West Germany).
CONTINUOUS NAVIGATION UPDATING METHOD BY MEANS OF AREA CORRELATION
A. Hessel and W. Eckl *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 19 p refs (For availability see N76-32148 23-04)

An autonomous automatic updating method is considered for the improvement of navigation accuracy. This is based upon the correlation between an instantaneously taken picture and a stored scene of the area of interest. The displacement between the actual position and the indicated position (taken from the simple basic system) is derived from the maximum crosscorrelation of the two pictures. Results of different correlation-algorithms applied to microwave images of different sizes and scene complexity (grey values) are shown. Topics for further research work necessary before flight testing such a system are outlined. Author

N76-32160 Wansbrough-White and Co. Ltd., London (England).
GRAPHIC AREA NAVIGATION WITH VOR/VOR, AND VOR/DME INPUTS
G. Wansbrough-White *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 17 p (For availability see N76-32148 23-04)

The following conclusions relative to some aspects of graphic area navigation were given and discussed. (1) area navigation offers advantages of safety and economy to both airlines and general aviation, with advantages to air traffic control, (2) area navigation must depend on conventional DR methods, with and without radio, in the low cost area of general aviation. There are pilot/navigator problems, and one development has been the airborne course line computer ('ghost VOR'), (3) another development is Graphic Area Navigation (GRNav), which uses standard VOR, DME (and other inputs), and is a computer based cartesian system that is self checking and geographically oriented, (4) GRNav has airways and marine applications, (5) GRNav has been shown to be a practical, simple and cheap navigation system, and is now subject to scientific evaluation in the UK and the USA. Author

N76-32161 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
INEXPENSIVE SYSTEM OF MULTIPLE BEACON LOCALIZATION FOR HELICOPTERS
Jacques Dorey *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 9 p refs In FRENCH; ENGLISH summary (For availability see N76-32148 23-04)

Two systems of angular (elevation and azimuth) localization of multiple beacons, for application to helicopters, are presented; - 2 system making use of the helicopter blades as receiving dipole support, in association with UHF emitting beacons; - a system making use of an independent rotating arm as dipole support, placed under the helicopter fuselage, in association with microwave emitting beacons. The first system is analyzed in detail; limitations of various kinds are emphasized, in particular those concerning the working wavelength. The data processing devices leading to the electromagnetic imagery of the beacon angular distribution are described. The second system, less applicable to helicopter, is presented and compared to the first one as regards its performance. Author

N76-32162 Naval Weapons Center, China Lake, Calif.
THE APPLICATION OF RING LASER GYRO TECHNOLOGY TO LOW-COST INERTIAL NAVIGATION
William F. Ball *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 16 p (For availability see N76-32148 23-04)

The Advanced Tactical Inertial Guidance System (ATIGS), a strapdown system using Ring Laser Gyros (RLGs), low-cost accelerometers, and large-scale integrated circuitry computer technology, was described. Although primarily developed for a long-range tactical missile application, the system mechanization that has evolved is directly applicable to aircraft inertial navigation. The first ATIGS unit entered captive flight evaluations in a pod on a A-7E aircraft on 20 June 1974. Results achieved during this first series of tests showed approximately 4 nmi/hr radial error. In March 1975, ATIGS was flight-tested as an aircraft navigator, with ground self-alignment and with flight times of 3 to 4 hours. In these tests an average circular error probable radial error of 2.16 nmi/hr was obtained. The Ring Laser Gyro RLG appears to offer a truly low-cost alternative for future aircraft inertial navigation based on the results of the ATIGS program. Further ATIGS results have indicated that excellent long-term stability can be expected from these unconventional instruments. These factors indicate that, if properly integrated with low-cost accelerometers and appropriate low-cost digital computers, a medium-accuracy, low cost inertial navigator is possible. Author

N76-32163 Singer Co., Little Falls, N.J. Aerospace and Marine Systems Div.
INERTIAL NAVIGATOR FOR COMMERCIAL AIRLINES
Julius Weiss *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 11 p refs (For availability see N76-32148 23-04)

The GAMMA Advanced Inertial Navigation System is an outgrowth of the SKN-2400 family of military inertial navigation equipment, and hence represents the present state of the art in advanced electronic packaging. The development of the GAMMA Advanced Inertial Navigation System, its physical and functional description and its impact, specifically on smaller general aviation aircraft, are described. The development of the system was completed after many months of qualification and flight testing under the aegis of the Federal Aviation Administration (FAA). The details of these tests and their results are provided. Author

N76-32164 Teledyne Ryan Aeronautical Co., San Diego, Calif.
LIGHTWEIGHT DOPPLER NAVIGATION SYSTEM
Robert E. Chapman *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 22 p (For availability see N76-32148 23-04)

A self contained, low cost, lightweight, accurate, and reliable navigation system for military helicopters was designed. The system consists of a Doppler Radar Velocity Sensor (DRVS) and a Computer Display Unit (CDU) with a combined mean time difference between failures of more than a 1000 hours, and a .38 percent circular error probability. The capability of the system to be integrated with radio-aided navigation systems such as LORAN and OMEGA is described. An important feature of the system is the capability of rapidly isolating failures to a replacable module, and ease of replacement of the 'failed' module. The use of a special modulation form in the DRVS to develop a coherent local oscillator is described. Also described is an IMPATT solid state transmitter, time duplexed travelling wave array antenna, and digital frequency tracker. Use of a single chip microprocessor in the CDU is described; emphasis on the human factors engineering aspects of the man-machine interface. Results indicate that system meets the requirements that it was designed for. J.R.T.

N76-32165 Singer Co., Wayne, N.J.
DOPPLER RADARS FOR LOW-COST, MEDIUM ACCURACY NAVIGATION
Heinz Buell *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 10 p (For availability see N76-32148 23-04)

A Lightweight Doppler Navigation System (LDNS) was designed which weighs under 30 pounds and has a predicted mean time difference between failures of over 1400 hours and a predicted navigation accuracy of 1.3% of distance travelled with 1% (1 sigma) heading reference. The system is designed for use in military helicopters. The LDNS consists of four units: (1) Doppler radar velocity sensor, consisting of a receiver transmitter antenna unit and signal data converter unit, (2) control display unit, and (3) steering hover indicator unit. Diagrams illustrating each unit are shown. Author

N76-32166 Ferranti Ltd., Edinburgh (Scotland).
TWO NEW SENSORS AND THEIR POSSIBILITIES IN LOW COST HEADING REFERENCE SYSTEMS
W. H. McKinlay, A. Liebing, and K. R. Brown *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 7 p (For availability see N76-32148 23-04)

The requirement for heading in a navigation system, both as primary data and for the pointing of certain sensors is discussed. The airborne applications of heading for fixed and rotating wing aircraft are examined. It is pointed out that developments in gyroscopes, resulting from inertial technology, now make it possible to provide a heading memory with a very low drift. But this is not usable unless the device can first be referenced to true North, which introduces the desirability of gyro-compassing. This, in turn, leads to certain instrument requirements. Two new sensors suitable for use on gimballed platforms but essentially of simple construction and relatively low cost. They are Double Integrating Angular Accelerometer and a Free Rotor Gyroscope, the Oscillogyro. Possible system configurations are indicated, and conclusions are drawn as to areas in which these techniques can most profitably be applied. Author

N76-32167 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
THE FNA 615: A SELF CONTAINED LOW-COST NAVIGATION SYSTEM FOR GROUND-VEHICLES
U. K. Krogmann *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 18 p refs (For availability see N76-32148 23-04)

The Fahrzeug-Navigations-Anlage system's application to a German artillery observation tank is examined. Required performance data and general requirements were met utilizing proven hardware. To meet the required very short initialization time a Meridian-Gyro was used for aligning the heading reference unit of the system. Built-in test hardware and software were incorporated to achieve high error detection and localization probability without the need for external test-equipment. Because the system is selfcontained it is thus insensitive regarding jamming. In its basic configuration it is essentially a low cost system and because of its modular design it can be modified and augmented easily. Author

N76-32168 Marconi-Elliott Avionic Systems Ltd., Rochester (England). Airport Works.
HELICOPTER AIR DATA MEASUREMENT
C. J. Frost *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 13 p (For availability see N76-32148 23-04)

A helicopter air data sensor system was developed which can provide accurate air data including forward, aftward, sideways and vertical airspeed information for flight control and navigation purposes. The helicopter air data system consists of the following equipment: (1) a multi-axis swivelling pilot static probe, (2) a digital air data computer, and (3) optional displays of altitude, altitude rate, calibrated airspeed, sideslip angle, combined torque and maximum torque, payload margin, and air temperature. Present helicopter air data sensors suffer from gross errors at flight velocities below 40 knots. The causes of these errors are the inability of airborne sensors to detect low air velocities or dynamic pressures, and the corruption of the pressure-flow field around the helicopter by the rotor induced flow. Photographs of the installed air data sensor system in a helicopter are provided. Author

N76-32169 Sperry Gyroscope Co. Ltd., Bracknell (England).
LOW COST SELF CONTAINED SOLUTIONS TO THE NAVIGATION PROBLEM IN ROTARY AND FIXED WING AIRCRAFT
E. Brewin (Decca Co., London), T. S. Kitching (Decca Co., London), and D. L. Wright *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 11 p (For availability see N76-32148 23-04)

Defense budget limitations often make it necessary for the operational staff of many air forces to review their avionics system requirements. Only limited reliance can be placed on the use of ground based radio aids while the high cost pure inertial solution far from satisfies the multiplicity of military aircraft roles with which the operational staffs have to contend. A Modular Building Block Concept for self contained systems is proposed which can be tailored to provide the required facilities and performance to meet a specific role while retaining a high degree of logistic commonality between differing aircraft types, and at a low cost. The proposed modular solution, already a fact with hardware in production and going into service is based upon the use of the following hardware elements: (1) a two/three axis velocity sensor, (2) a two/three axis heading/attitude sensor, and (3) a digital navigation computer. The possibility of coupling of these systems to a range of weapon delivery equipment is suggested. Author

N76-32170 Rockwell International Corp., Anaheim, Calif.
HAND HELD CALCULATOR TECHNOLOGY APPLIED TO AN ADVANCED LOW COST OMEGA RECEIVER
Bernard N. Gaon *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 9 p refs (For availability see N76-32148 23-04)

Recent technological advances in metal oxide semiconductor circuitry have resulted in mass production of commercial calculators and with it the availability of low cost microprocessors. These devices, although limited in computational capability, can be successfully applied to the development of a low cost Omega navigation set. The basic desirable features of an airborne Omega

receiver were studied, and the required functions identified. A simplified technique to achieve better accuracy was identified. The ways in which microprocessors can be utilized to arrive at a low cost, fully automatic composite airborne system are outlined. The receiver and processor portions of the Omega set are detailed. Prototype hardware that has been flight tested is described, and performance data are presented. The basic function of the Omega set is to determine and keep track of present position by receiving and processing the Omega very low frequency transmissions. Photographs of the control and display units of the Omega set are provided. Author

N76-32171 Marconi-Elliot Avionic Systems Ltd., Basildon (England).
THE APPLICATION OF MINI-PROCESSORS TO NAVIGATION EQUIPMENT
M. R. Hopper *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 11 p (For availability see N76-32148 23-04)

Modern technology has allowed the production of a very small miniature processor using integrated circuit techniques. Because of it's simplicity and size, the same processor can be used variously, to process information from a variety of different inputs, to provide information to drive various output peripherals, or to process information within a dedicated equipment. The design requirements for, and the operation of such a mini-processor are considered. It's uses are illustrated by it's inclusion in a piece of dedicated navigation equipment (TACAN), where it is used to solve a particular set of data. Also it is considered in a family of area navigation systems, where it's flexibility is illustrated by the varying requirements of such systems. Photographs of display devices, digital computers and other components used are shown. Author

N76-32172 National Aerospace Lab., Amsterdam (Netherlands).
A MATHEMATICAL MODEL FOR THE ANALYSIS OF NAVIGATION SYSTEM ERRORS OF MODERN FIGHTER AIRCRAFT
F. J. Abbink and N. VanDriel *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 11 p refs (For availability see N76-32148 23-04)

An error analysis of an inertial navigation system by computerized simulation is presented. In order to compute the standard deviations of the navigation system errors, the matrix equation representing the set of linearized differential equations for the navigation system error behavior was transformed into an evolution equation for the covariance matrix. The navigation system error model took into account, alignment, navigation along a specific flight profile and updating. Position error distributions were calculated and analyzed for different flight profiles, with and without updating for a specific type of inertial navigation system. Author

N76-32173 ITT Avionics, Nutley, N.J.
MEDIUM ACCURACY, LOW COST NAVIGATION: LORAN-C VERSUS THE ALTERNATIVES
J. P. VanEtten *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 24 p refs (For availability see N76-32148 23-04)

The fundamentals of the Loran C system are compared with the fundamentals of alternative navigation systems (Omega, Decca, Loran D). The operational merit, the universal applicability, and the economy of Loran C are discussed. The use of Loran C as a low cost navigation system on a national and international level is examined. The use of Loran C in military, nonmilitary, and commercial air service is also considered. Radio frequencies and bandwidth used by Loran C and other navigation systems are cited. Also provided are block diagrams of a generalized radio navigation receiver. Author

N76-32174 Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
SYSTEM APPROACH TO PRACTICAL NAVIGATION
Jin W. Chin and Russell E. Weaver, Jr. (Northrop Electronics Div.) *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 14 p refs (For availability see N76-32148 23-04)

A background introduction is presented of various navigation sensors discussing their characteristics and limitations. The forthcoming satellite navigation system, NAVSTAR Global Positioning System (GPS), will be exploited as an ultimate capability of providing L Band signals from which position, velocity, and time can be determined. This dual capability will simplify the implementation of integrated systems. A typical medium accuracy system is described. The widely accepted inclusion of an inertial subsystem will be emphasized on the merit of a multifunctional capability beyond that for navigation. Roles in flight control, instrumentation, and augmentation of mission avionics are recognized. The strapdown mechanization and associated instruments are introduced to discuss a potential alternative to the conventional all attitude, gimballed platform. These advances provide the attributes to accomplish low cost designs of medium accuracy navigation systems. Integration of available sensor data to provide the required navigation performance is considered the most effective method of attaining low cost equipment. Modularity expressed in the design will provide flexibility and adaptability to a broad class of users. A total performance, costs of ownership, approach is used to verify system design and selection. Author

N76-32175 Decca Navigator Co. Ltd., Chessington (England). SSM Div.
INTEGRATED DOPPLER/HEADING REFERENCE/RADIO NAVIGATION
D. Halliwell *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 9 p (For availability see N76-32148 23-04)

Medium accuracy low cost navigation systems provide flexibility of operation with the minimum of limitations, while retaining the major benefits of simplicity of concept and of design. A simple system concept based on currently available equipments is outlined. A DR system based on a currently available gyromagnetic heading reference and a fixed-aerial Doppler radar is assessed as capable of two sigma accuracy in the range 1% to 3% of distance flown. For operations requiring consistent accuracy over long periods of flight or accurate relative navigation the DR system is supplemented by a simple Omega receiver front-end, the signals being processed in the DR system computer. The system is capable of providing medium to high accuracy navigation at low total cost for a wide range of helicopter and aircraft operational requirements. Author

N76-32176 Computing Devices of Canada, Ltd., Ottawa (Ontario).
AN OPTIMALLY INTEGRATED PROJECTED MAP NAVIGATION SYSTEM
D. B. Reid, R. K. Harman, and D. J. Frame *In* AGARD Medium Accuracy Low Cost Navigation Aug. 1976 31 p refs (For availability see N76-32148 23-04)

A unique integrated tactical navigation system (ITNS) concept for helicopter applications is described. This concept, which could be extended for application in high performance tactical aircraft, is based on the projected map system, PMS 5-6, currently in production. The primary navigation unit of the ITNS is the Doppler dead reckoning (DR) subsystem which uses simple directional and vertical gyros as heading and attitude sensors. Auxiliary navigation data are supplied by a projected map display (PMD) and a triad of magnetometers strapped to the airframe. The PMD displays aircraft position, track and bearing to destination pictorially, providing excellent pilot orientation and position fixing capability. The magnetic sensor measures three components of the earth's field, from which additional heading and attitude information are derived. A digital Kalman filtering algorithm is implemented to estimate system errors from DR, PMD and strapdown magnetic data. The error estimates are fed back to correct DR position and null sensor errors, resulting in a fully integrated system which provides excellent performance at low cost. Simulation results indicate that system accuracy without position fixes will be better than 2 per cent of distance travelled (95 per cent confidence). Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N76-32177*# Illinois Univ., Urbana. Dept. of Aeronautical and Astronautical Engineering.
DEVELOPMENT OF CRITERIA FOR THE DESIGN OF A LOW NOISE LEVEL GENERAL AVIATION PROPELLER Semiannual Status Report
Allen I. Ormsbee Aug. 1976 102 p refs
(Grant NGR-14-005-194)
(NASA-CR-147979) Avail: NTIS HC $5.50 CSCL 01A

The theoretical and experimental investigation of general aviation propellers is considered. The objective is to improve noise generation characteristics without loss of performance. Author

N76-32178*# McDonnell Aircraft Co., St. Louis, Mo.
WIND TUNNEL AND GROUND STATIC INVESTIGATION OF A LARGE SCALE MODEL OF A LIFT/CRUISE FAN V/STOL AIRCRAFT
2 Aug. 1976 413 p refs
(Contract NAS2-8655)
(NASA-CR-137916; MDC-A4318) Avail: NTIS HC$11.00 CSCL 01C

An investigation was conducted in a 40 foot by 80 foot wind tunnel to determine the aerodynamic/propulsion characteristics of a large scale powered model of a lift/cruise fan V/STOL aircraft. The model was equipped with three 36 inch diameter turbotip X376B fans powered by three T58 gas generators. The lift fan was located forward of the cockpit area and the two lift/cruise fans were located on top of the wing adjacent to the fuselage. The three fans with associated thrust vectoring systems were used to provide vertical, and short, takeoff and landing capability. For conventional cruise mode operation, only the lift/cruise fans were utilized. The data that were obtained include lift, drag, longitudinal and lateral-directional stability characteristics, and control effectiveness. Data were obtained up to speeds of 120 knots at one model height of 20 feet for the conventional aerodynamic lift configuration and at several thrust vector angles for the powered lift configuration. Author

N76-32179*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HUMAN CONFORT RESPONSE TO RANDOM MOTIONS WITH A DOMINANT ROLLING MOTION
Ralph W. Stone, Jr. Jul. 1975 95 p refs
(NASA-TM-X-72747) Avail: NTIS HC $5.00 CSCL 05E

Subjective ride comfort response ratings were measured on a visual motion simulator with rolling velocity inputs with various power spectra shapes and magnitudes. The results show only little influence of spectra shape on comfort response. The effects of magnitude on comfort response indicate the applicability of psychophysical precepts for comfort modeling. Author

N76-32180*# Martin Marietta Corp., Denver, Colo.
X-24C RESEARCH VEHICLE
Oct. 1974 82 p refs Sponsored in part by NASA and AF
(NASA-CR-148832; M-74-9) Avail: NTIS HC $5.00 CSCL 01C

A group of experiments that might be accomplished on the X-24C research vehicle are discussed indicating in each case the technology development needed to ready the experiments for flight, and also indicating interface problems between the vehicle and the experiment. Experiments that could be cheaply done using test platforms other than the X-24C have been eliminated. Experiments that are clearly applicable only to the X-24C research vehicle are, of course, included. Experiments that might be accomplished on either the X-24C or some other platform requiring further investigation concerning proper applicability are included for consideration. Author

N76-32181*# Boeing Commercial Airplane Co., Seattle, Wash.
THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT SERVICE EVALUATION Annual Report, Jul. 1973 - Mar. 1975
Robert L. Stoecklin May 1975 39 p refs
(Contract NAS1-11668)
(NASA-CR-132663; AR-1) Avail: NTIS HC $4.00 CSCL 01C

The flight service experience of 108 graphite-epoxy spoilers on 737 transport aircraft, and related ground-based environmental exposure of graphite-epoxy material specimens were evaluated. Four spoilers were installed on each of 27 aircraft for a 5-year study. As of February 28, 1975, a total of 294,280 spoiler flight-hours and 460,686 spoiler landings were accumulated. Based on visual, ultrasonic, and destructive testing, no moisture migration into the honeycomb core and no core corrosion has occurred. Tests of removed spoilers and of ground-based exposure specimens after the first year of service indicate no significant changes in composite strength. Author

N76-32182*# Boeing Co., Wichita, Kans.
EVALUATION OF LOW WING-LOADING FUEL CONSERVATIVE, SHORT-HAUL TRANSPORTS
L. H. Pasley and T. A. Waldeck 1976 305 p refs
(Contract NAS1-13714)
(NASA-CR-145041) Avail: NTIS HC $9.75 CSCL 01C

Fuel conservation that could be attained with two technology advancements, Q fan propulsion system and active control technology (ACT) was studied. Aircraft incorporating each technology were sized for a Federal Aviation Regulation (FAR) field length of 914 meters (3,000 feet), 148 passengers, and a 926 kilometer (500 nautical mile) mission. The cruise Mach number was .70 at 10100 meter (33,000 foot) altitude. The improvement resulting from application of the Q fan propulsion system was computed relative to an optimized fuel conservative transport design. The performance improvements resulting from application of ACT technology were relative to the optimized Q fan propulsion system configuration. Author

N76-32183# Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCES IN ENGINE BURST CONTAINMENT AND FINITE ELEMENT APPLICATIONS TO BATTLE-DAMAGED STRUCTURE
Sep. 1976 22 p refs Presented at 42d Struct. and Mater. Panel Meeting, Ottawa, Apr. 1976
(AGARD-R-648) Avail: NTIS HC $3.50

Two papers dealing with protection systems for aircraft against damage arising from the impact of a variety of projectiles such as military weapons and debris from engine disintegration were presented. For individual titles, see N76-32184 through N76-32185.

N76-32184 Boeing Co., Seattle, Wash.
ADVANCES IN ENGINE BURST CONTAINMENT
R. J. Bristow, C. D. Davidson, and J. H. Gerstle *In* AGARD Advan. in Eng. Burst Containment and Finite Elem. Appl. to Battle-Damaged Struct. Sep. 1976 p 1-6 (For availability see N76-32183 23-05)

A partial review of recent research performed into the application of fragment impact studies leading to an understanding of engine burst fragment impacts and the initial development of an engine burst containment system using duPont Kevlar material were described. All test work to date has involved translational accelerators. The program has not yet resulted in a satisfactory containment system. In addition to a summary of program accomplishments, several areas where unexpected results occurred and where information was obtained that may influence future fragment containment efforts were discussed. One of these areas involves spinning fragments. None of the predicted adverse effects on Kevlar fabric was found. Another area concerns thermal effects. It was found that the efficiency of the barrier in stopping fragments was influenced by the temperature of the Kevlar. Author

N76-32185 Naval Surface Weapons Center, White Oak, Md.
FINITE ELEMENT APPLICATIONS TO BATTLE DAMAGED STRUCTURE
Pao C. Huang *In* AGARD Advan. in Eng. Burst Containment and Finite Elem. Appl. to Battle-Damaged Struct. Sep. 1976 p 7-16 refs (For availability see N76-32183 23-05)

A 'Patching Technique' for the development of a finite element model truly representing a battle-damaged aircraft was introduced. The applications of the preprocessors Ping and Bing to the automatic generation of input data for NASTRAN analyses are also briefly shown. Finally, the importance of modeling technique is addressed. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N76-32186*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLID-STATE TURN COORDINATOR DISPLAY
Barry D. Meredith, Roger K. Crouch, and W. Lane Kelly, IV Aug. 1975 16 p ref
(NASA-TM-X-72782) Avail: NTIS HC $3.50 CSCL 01D

A solid state turn coordinator display which employs light emitting diodes (LED's) as the display medium was developed to demonstrate the feasibility of such displays for aircraft applications. The input to the display is supplied by a fluidic inertial rate sensor used in an aircraft wing leveler system. The display is composed of the LED radial display face and the electronics necessary to address and drive the individual lines of LED's. Three levels of brightness are provided to compensate for the different amounts of ambient light present in the cockpit. Author

N76-32187# Illinois Univ., Savoy. Aviation Research Lab.
ADVANCED INTEGRATED AIRCRAFT DISPLAYS AND AUGMENTED FLIGHT CONTROL. VOLUME 1: SCIENTIFIC FINDINGS
Stanley N. Roscoe, Janice E. Eisele, and Craig A. Bergman Jun. 1975 56 p refs
(Contract N00014-76-C-0081; NR Proj. 196-133)
(AD-A022459; ARL-75-12/ONR-75-2-Vol-1) Avail: NTIS CSCL 01/4

This integrative report is divided into two volumes. Volume I introduces a classification of aircraft displays and controls, and reviews problems that have plagued their evolution, and advances the pilot's task hierarchy as a conceptual framework within which available information can be abstracted, integrated, and applied to the design of displays and controls. In particular, Volume I constitutes a bringing together and integration of the findings from the various historical lines of investigation associated with quickening and unburdening, contact analog displays, predictor displays, frequency-separated displays, and performance control systems. Author (GRA)

N76-32188# Illinois Univ., Savoy.
ADVANCED INTEGRATED AIRCRAFT DISPLAYS AND AUGMENTED FLIGHT CONTROL. VOLUME 2: APPENDICES
Dennis Daly, Douglas J. Collins, and Robert A. Ruby Jun. 1975 204 p refs
(Contract N00014-76-C-0081; NR Proj. 196-133)
(AD-A022460; ARL-75-12/ONR-75-2-Vol-2) Avail: NTIS CSCL 01/4

Volume II contains reports detailing the past year's hardware efforts. Hardware specific to Phase II simulation and experimentation was designed, built, and installed. Volume II describes equipment necessary to continuing research on computer-augmented controls and computer-generated displays.
Author (GRA)

N76-32189# Hughes Aircraft Co., Culver City, Calif. Display Systems and Human Factors Dept.
IMAGE ENHANCEMENT TECHNIQUES FOR COCKPIT DISPLAYS Final Report, Feb.-Sep. 1975
D. J. Ketcham, R. W. Lowe, and J. W. Weber Mar. 1976 91 p refs
(Contract N00014-74-C-0313)
(AD-A023122; HAC-P75-497; HAC-Ref-D0802; ONR-CR213-124-2) Avail: NTIS CSCL 17/8

Image processing has been the subject of extensive research and keen interest over the past years. However, little of this work has been oriented toward processing techniques for real-time picture restoration and enhancement. This report covers three areas directed at real-time processing; the sensitivity to noise of three image enhancement techniques, Haar transform non-linear filtering, and blur restoration. Author (GRA)

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N76-32190*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL CLEAN COMBUSTOR PROGRAM, PHASE 2 Final Report
C. C. Gleason, D. W. Rogers, and D. W. Bahr Aug. 1976 208 p refs
(Contract NAS3-18551)
(NASA-CR-134971; R76AEG422) Avail: NTIS HC $7.75 CSCL 21E

The primary objectives of this three-phase program are to develop technology for the design of advanced combustors with significantly lower pollutant emission levels than those of current combustors, and to demonstrate these pollutant emission reductions in CF6-50C engine tests. The purpose of the Phase 2 Program was to further develop the two most promising concepts identified in the Phase 1 Program, the double annular combustor and the radial/axial staged combustor, and to design a combustor and breadboard fuel splitter control for CF6-50 engine demonstration testing in the Phase 3 Program. Noise measurement and alternate fuels addendums to the basic program were conducted to obtain additional experimental data. Twenty-one full annular and fifty-two sector combustor configurations were evaluated. Both combustor types demonstrated the capability for significantly reducing pollutant emission levels. The most promising results were obtained with the double annular combustor. Rig test results corrected to CF-50C engine conditions produced EPA emission parameters for CO, HC, and NOX of 3.4, 0.4, and 4.5 respectively. These levels represent CO, HC, and NOX reductions of 69, 90, and 42 percent respectively from current combustor emission levels. The combustor also met smoke emission level requirements and development engine performance and installation requirements. Author

N76-32191*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Product Div.
PRELIMINARY COMPRESSOR DESIGN STUDY FOR AN ADVANCED MULTISTAGE AXIAL FLOW COMPRESSOR Final Report
H. V. Marman and R. D. Marchant Sep. 1976 61 p refs
(Contract NAS3-19445)
(NASA-CR-135091; PWA-5386) Avail: NTIS HC $4.50 CSCL 21E

An optimum, axial flow, high pressure ratio compressor for a turbofan engine was defined for commercial subsonic transport service starting in the late 1980's. Projected 1985 technologies were used and applied to compressors with an 18:1 pressure ratio having 6 to 12 stages. A matrix of 49 compressors was developed by statistical techniques. The compressors were evaluated by means of computer programs in terms of various airline economic figures of merit such as return on investment and direct-operating cost. The optimum configuration was determined to be a high speed, 8-stage compressor with an average blading aspect ratio of 1.15. Author

N76-32192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DURABILITY OF ZIRCONIA THERMAL-BARRIER CERAMIC COATINGS ON AIR-COOLED TURBINE BLADES IN CYCLIC JET ENGINE OPERATION
Curt H. Liebert, Richard E. Jacobs, Stephan Stecura, and C. Robert Morse Washington Sep. 1976 17 p refs
(NASA-TM-X-3410; E-8700) Avail: NTIS HC $3.50 CSCL 21E

Thermal barrier ceramic coatings of stabilized zirconia over a bond coat of Ni Cr Al Y were tested for durability on air cooled turbine rotor blades in a research turbojet engine. Zirconia stabilized with either yttria, magnesia, or calcia was investigated.

On the basis of durability and processing cost, the yttria stabilized zirconia was considered the best of the three coatings investigated. Author

N76-32193# Ohio State Univ. Research Foundation, Columbus.
GAS TURBINE TRANSPIRATION COOLING RESEARCH. PART 1: AN EXPERIMENTAL STUDY OF TURBINE AIRFOIL WAKES AS INFLUENCED BY UPSTREAM NOZZLE VANES Final Report, 1 Jan. 1973 - 30 Sep. 1975
Wesley R. Cox and L. S. Han Wright-Patterson, AFB, Ohio AFAPL Nov. 1975 172 p refs
(Contract F33615-73-C-2033; AF Proj. 3066)
(AD-A023445; OSURF-3611-IF-Pt-1; AFAPL-TR-76-2-Pt-1) Avail: NTIS CSCL 21/5

An experimental study was made of the effects of stationary upstream wakes on the static pressure distribution and wake profiles of a downstream cascade of turbine blade models. The most significant cyclic static pressure changes on the downstream airfoils were found to take place along the suction surface and near the stagnation region of an instrumented airfoil. The wake minimum velocity was found to be displaced toward the suction side of the airfoil by the addition of an upstream cascade, although no significant change was found to occur when the relative position of the cascades was changed. The results suggest that an upstream cascade may effectively be modeled as an increase in free-stream turbulence for predicting its effects on the downstream wakes. GRA

N76-32194# Ohio State Univ. Research Foundation, Columbus.
GAS TURBINE TRANSPIRATION COOLING RESEARCH. PART 3: PREDICTION OF TRANSITION REGION LOCATION AND EXTENT FOR THE EFFECTS OF SURFACE CURVATURE, FREE-STREAM TURBULENCE, PRESSURE GRADIENTS, WALL TEMPERATURE, AND UNIT REYNOLDS NUMBER Final Report, 1 Jan. 1973 - 30 Sep. 1975
Wesley R. Cox and Lit S. Han Wright-Patterson, AFB, Ohio AFAPL Sep. 1975 87 p refs
(Contract F33615-73-C-2033; AF Proj. 3066)
(AD-A022969; AFAPL-TR-76-2-Pt-3) Avail: NTIS CSCL 21/5

A survey of boundary layer transition literature is made with emphasis on the effects of surface curvature, free-stream turbulence, pressure gradients, heat transfer, and unit Reynolds number. Brief reviews of significant literature on each of the effects are presented. A discussion of methods for predicting the transition region, with emphasis on conditions commonly found in turbomachinery, is also presented. An extensive bibliography and representative figures and plots are provided. Author (GRA)

N76-32195# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
A MULTI-VARIABLE CONTROL FOR THE F100 ENGINE OPERATING AT SEA LEVEL STATIC Technical Report, Jan. - Jun. 1975
Marc S. Weinberg Nov. 1975 47 p refs
(AD-A022699; ASD-TR-75-28) Avail: NTIS CSCL 21/5

This report describes a multi-variable control for the F100 engine operating at sea level static. It represents one phase of an in house effort to develop practical applications of modern control theory to gas turbine engines. GRA

N76-32196# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
LIFT FAN PROPULSION CONCEPTS STUDY Interim Report, Mar. 1975 - Feb. 1976
Donald P. Gleiter 25 Mar. 1976 49 p refs
(WF41411000)
(AD-A023087; NADC-76079-30) Avail: NTIS CSCL 21/5

Contractor's conceptual designs of multimission lift fan VSTOL aircraft based on two different fan designs, one with a tip-turbine drive and one with a mechanical drive, were compared to determine the more suitable propulsion system for a Navy ASW aircraft with an initial operational capability in 1985. The comparison was based on consideration of propulsion system performance, propulsion-induced effects, propulsion system effects on flying qualities and control system design, aircraft mission performance, propulsion system cost, aircraft reliability and maintainability, and propulsion system vulnerability. The mechanically-driven fans were found to be more suitable, primarily because of differences in mission performance and cost. However, it was determined that aircraft could be designed to meet Navy mission requirements using either fan design. An aircraft design based on the mechanically-driven fan concept was optimized to an ASW mission for comparison with the contractor's multimission aircraft. It was found that the contractor's takeoff gross weight estimates accurately represented an aircraft optimized for the ASW mission. Author (GRA)

N76-32197# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
CAN-TYPE COMBUSTOR DESIGN FOR A LOW COST SUBSONIC RAMJET ENGINE Final Technical Report, 1 Apr. 1974 - 1 Apr. 1975
Charles E. Hornbeck Dec. 1975 81 p refs
(AF Proj. 3012)
(AD-A023471; AFAPL-TR-75-71) Avail: NTIS CSCL 21/5

This study investigates the feasibility of using a low cost can combustor in a subsonic ramjet engine in the flight envelope of Mach 0.7 to 0.9, altitude 20,000 to 30,000 feet. A simple can combustor without close fabrication tolerances was designed and fabricated. The can was installed in a subsonic ramjet which was ground tested in a direct-connect pipe set-up. The combustion efficiency and thrust were determined at conditions representative of the flight envelope. These results are compared with results of a model subsonic ramjet engine cycle analysis. The end result of the program is a developed combustor system for a subsonic ramjet which is an inexpensive and attractive propulsion device for one-mission remotely piloted vehicles and target drones. Author (GRA)

N76-32198# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
DUMP DIFFUSER INLET PROGRAM Final Report, Sep. 1972 - Apr. 1973
M. Brian Bergsten Feb. 1976 127 p refs
(AF Proj. 3012)
(AD-A023404; AFAPL-TR-75-33) Avail: NTIS CSCL 21/5

In an investigation of variable geometry inlets and nozzles for application to integral rocket ramjet engines, one of the inlet concepts included a variable ramp which produced a discontinuity in the diffuser region unless a trailing flap was used. The purpose of the program described herein was to evaluate the effect of this discontinuity and provide information for determining whether or not the added complexity and weight of a trailing flap would be required to obtain acceptable inlet performance. The approach undertaken was an experimental program in the Mach 3 wind tunnel with an inlet model incorporating a variable dump diffuser. The model was designed with interchangeable components to provide numerous configurations. GRA

N76-32199# General Electric Co., Schenectady, N.Y. Gas Turbine Products Div.
OPERATIONAL PERFORMANCE VERIFICATION OF ADVANCED GAS TURBINE TECHNOLOGY Final Report
S. M. Kaplan 31 Dec. 1975 144 p
(Contract MA-4-37123)
(PB-251087/3; Doc-75GTD67; MA-RD-920-76036) Avail: NTIS HC $6.00 CSCL 21E

This final report encompasses all turbine testing-related efforts and detailed test data evaluations. The turbine was operated on washed, conditioned residual fuel oil at firing temperatures above 1750F to 871 hrs (743 of which were at or above 1850F). Test data evaluations indicate that all program objectives were met. The MARAD Project developed technology and components under test were like-wise verified under this program. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

No abstracts in this category.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N76-32200*# Calspan Corp., Buffalo, N.Y.
APPLICATION OF THE ADAPTIVE-WALL CONCEPT TO THREE-DIMENSIONAL LOW-SPEED WIND TUNNELS
J. C. Erickson, Jr. Sep. 1976 77 p refs
(Contract NAS2-8777)
(NASA-CR-137917; RK-5717-A-1) Avail: NTIS HC $5.00 CSCL 14B

Three methods for evaluating the functional relationships required to obtain interference-free flows about a model in a wind tunnel have been developed. The first, the original multipole expansion (MPE) procedure, is based on a series of point singularities which satisfy the governing Prandtl-Glauert equation. The second, the modified MPE, provides an improved representation of finite-span wings and thereby extends the range of validity of the original MPE to larger ratios of span-to-control-surface-width. The third method is more general and is based on source distributions over the control surface. Several numerical examples are presented to help establish the range of validity of these methods. An accuracy-assessment procedure, which combines the original MPE procedure with classical wall-correction theory, has been developed to estimate the degree of interference at the model if the functional relationships are not satisfied exactly. Several numerical examples are presented for representative wings and bodies. Author

N76-32201*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL BLOCKAGE TESTS AT MACH 5 OF VACUUM DUCT MODELS FOR TWO SOUND RADIATION SHIELDS
Ivan E. Beckwith and William D. Harvey Sep. 1975 29 p refs
(NASA-TM-X-72772) Avail: NTIS HC $4.00 CSCL 14B

Two sound shield models with dummy vacuum exhaust ducts were tested in a Mach 5 pilot quiet tunnel. The first model simulates a new sound shield of 3 in. (7.62 cm) inside diameter and the second model is a shield of 4 in. (10.16 cm) inside diameter. The dummy vacuum exhaust ducts were attached to the external housing of the models. The flow in the first model, which had a by pass mass flow ratio of about 0.6, could not be started except at the two highest test Reynolds numbers where only the central core flow region was started. The flow in the second model with a mass ratio of approximately 0.3 was fully started except at the lowest unit Reynolds number where some unsteadiness and partial flow separation at the wall was observed. Since the external housing and dummy vacuum ducts were the same for both models, these results indicate that the ratio of by pass mass flow to total mass flow for a wind tunnel sound shield of this particular design must be less than about 0.3. Hence, a lower limit is imposed on the inlet diameter of the sound shield in relation to the exit diameter of the wind tunnel nozzle. This lower limit on the inlet diameter may possibly be reduced by improvements in streamlining of the external housing and ducts, by reductions in blockage area, or by the use of external ducting shrouds. Author

N76-32202*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
SOFTWALL ACOUSTICAL CHARACTERISTICS AND MEASUREMENT CAPABILITIES OF THE NASA LEWIS 9x15 FOOT LOW SPEED WIND TUNNEL
Peter E. Rentz Jun. 1976 103 p refs
(Contract NAS3-19410)
(NASA-CR-135026; BBN-3176) Avail: NTIS HC $5.50 CSCL 14B

Acoustical characteristics and source directionality measurement capabilities of the wind tunnel in the softwall configuration were evaluated, using aerodynamically clean microphone supports. The radius of measurement was limited by the size of the test section, instead of the 3.0 foot (1 m) limitation of the hardwall test section. The wind-on noise level in the test section was reduced 10 dB. Reflections from the microphone support boom, after absorptive covering, induced measurement errors in the lower frequency bands. Reflections from the diffuser back wall were shown to be significant. Tunnel noise coming up the diffuser was postulated as being responsible, at least partially, for the wind-on noise in the test section and settling chamber. The near field characteristics of finite-sized sources and the theoretical response of a porous strip sensor in the presence of wind are presented. Author

N76-32203*# McDonnell Aircraft Co., St. Louis, Mo.
EXPANSION OF FLIGHT SIMULATOR CAPABILITY FOR STUDY AND SOLUTION OF AIRCRAFT DIRECTIONAL CONTROL PROBLEMS ON RUNWAYS, PHASE 1 Final Report
15 Mar. 1975 109 p refs
(Contract NAS1-13378)
(NASA-CR-145084; MDC-A3304) Avail: NTIS HC $5.50 CSCL 14B

The MCAIR five-degree-of-freedom motion-base simulator (MBS) was used in combination with a six-degree-of-freedom aircraft mathematical model to demonstrate the simulation adequacy on uncrowned runways, under various conditions. Known aircraft parameters were used where possible to increase program credibility. Tire-runway friction models were coordinated with personnel of NASA, Langley Research Center. The F-4 experienced pilots representing NASA, FAA, and USAF participated in the 130 approach-touchdown-rollout demonstration and verified the simulation adequacy. Author

N76-32204# Applied Science Associates, Inc., Valencia, Pa.
DOPPLER SIMULATOR CMA-544/T (H) TRAINING Final Report, 24 Jun. 1974 - 23 Sep. 1975
Dennis L. Scott and Reid P. Joyce Sep. 1975 15 p
(Contract F33615-74-C-5154; AF Proj. 1194)
(AD-A022942; AFHRL-TR-76-32) Avail: NTIS CSCL 05/9

This document is one of the six special test equipment programs. It concerns the CMA-544/T (H) Doppler Simulator, used in maintaining the AN/APN-147 Doppler Radar. This program requires the use of the Radar Bench Test Setup. The program guides the user through a series of hands on exercises that requires him to practice the use of each of the functions of this test equipment. GRA

N76-32205# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN OPTIMAL STATE ESTIMATOR FOR THE FJSRL INSTRUMENT TEST PLATFORM M.S. Thesis
Richard L. Brunson Mar. 1976 97 p refs
(AD-A023173; GE/EE/76M-1) Avail: NTIS CSCL 14/2

This study is directed toward the development of an optimal state estimator for the Frank J. Seiler Research Laboratory instrument testing platform. The estimator provides the platform state estimate to a digital controller which in turn acts as a linear regulator in attempting to drive the platform states to zero. An estimator is desirable since it allows consideration of the stochastic nature of the platform driving function and it also provides compensation for error sources attributed to the sensors affixed to the platform. The study first derives a system model for the platform, actuators, and sensors. This model embodies all available dynamics information relevant to the platform. The system model is simplified to the lowest order estimator that provides acceptable performance through the use of a covariance

analysis. Due to the rather short gain transients compared to the total time of interest the estimator is further simplified to a constant gain estimator. Next the implementation considerations for the estimator are investigated and the estimator algorithm developed. GRA

N76-32206# Advanced Technology Labs., Inc., Westbury, N.Y.
ON THE DEVELOPMENT OF INTERFERENCE-FREE TRANSONIC WIND TUNNELS
P. Baronti and A. Ferri Dec. 1975 14 p refs
(Contract N00014-73-C-0201; NR Proj. 061-205)
(AD-A022754; ATL-TR-223) Avail: NTIS CSCL 14/2

A series of analyses and experiments has been performed to explore the feasibility of a method of wall corrections leading to adaptive walls for interference-free conditions in transonic wind tunnels. A summary of the relevant results is presented. The investigation has indicated that with a modification of a slotted wall by a contouring of the slats a substantial improvement towards interference-free conditions was achieved. The modification, however, was not capable of producing a substantial displacement of the shock toward expected interference-free values. The reasons for this result are discussed and attributed, most likely, to the effect of a pressure at the end of the test section higher than the free stream value. GRA

N76-32207# Armament Development and Test Center, Eglin AFB, Fla.
LAYOUT AND CALIBRATION OF THE RAIN SIMULATION FACILITY AT THE HOLLOMAN TEST TRACK Final Report
Friedrich P. Ehni 15 Nov. 1976 82 p refs
(AD-A022600; ADTC-TR-75-83) Avail: NTIS CSCL 14/2

This Test Track Rain Simulation Facility extends over one rail of the 50,000 ft track in sections of 400 ft length up to a total length of 18,000 ft. An overview of the physical layout, control set-up, test set-up and test instrumentation is given. Performance data expressed in terms of drop number distribution over eight drop size classes from 0.5 to 4 mm, equivalent rain rate, liquid water content, and median mass diameter are presented; and, the constants of a least square exponential approximation to drop size distribution are included for nine rows of sample volume locations. Also included are graphs for the estimation of the number and size of drops encountered by a test specimen moving through the rain field. GRA

N76-32208# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FLOW FIELD DIAGNOSTICS IN THE COMPRESSOR RESEARCH FACILITY ONE-TENTH SCALE FLOW MODEL M.S. Thesis
Tsuyoshi Shinji Sep. 1975 129 p refs
(AD-A023360; GAM/AE/75S-20) Avail: NTIS CSCL 14/2

The Air Force Aero Propulsion Laboratory is developing a compressor research facility (CRF). The facility must provide a metered flow at a given pressure which is uniform in temperature and velocity at the compressor inlet. In this study the flow field of a one-tenth scale flow model of the CRF, constructed by a contractor for the Air Force Aero Propulsion Laboratory, was investigated. Velocity measurements made with a constant temperature anemometer using hot wire sensors provided the basis for establishing velocity profiles and turbulence intensity levels. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N76-32209 Catholic Univ. of America, Washington, D.C.
SKYLAB LESSONS LEARNED AS APPLICABLE TO A LARGE SPACE STATION Ph.D. Thesis
William Charles Schneider 1976 341 p
Avail: Univ. Microfilms Order No. 76-20233

Some of the lessons learned in the development of the Skylab program were recorded so that they will be available for the space station of the future. The approach taken is to list the lesson which, it is expected, will have wide application. The lesson is then amplified and explained in light of the background and experiences of the Skylab development. Both positive and negative examples are presented on a variety of technical and managerial issues. Dissert. Abstr.

N76-32210# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SPACE PROCESSING AND ELECTRONIC CERAMIC CRYSTALS
S. C. Hayden Mar. 1976 13 p refs
(Contract NAS8-31152)
(Doc-76SDS014) Avail: GE/Space and RESD Libraries, P. O. Box 8555, Philadelphia, Pa. 19101 HC $10.00/MF $10.00

This study was concerned with the possibility of performing relevant experiments in the perfection of single crystals of the dielectric-elastic-magnetic type on short duration rocket flights. It was concluded that the opportunities are severly limited. Author

N76-32211*# Joint Publications Research Service, Arlington, Va.
HANDSHAKE IN SPACE. A SPECIAL PUBLICATION
B. Konovalov, comp., M. Rostarchuk, comp., and G. Ostroumov, ed. Washington NASA Aug. 1976 308 p refs Transl. into ENGLISH of the book "Rukopozhatiye v kosmose. Spetsialnyy vypusk" Moscow, Izvestiya Press, 1975 p 1-480
(NASA-TT-F-17045) Avail: NTIS HC $9.75 CSCL 22A

The joint Soviet-American space flight operation in July 1975, in which the Soviet Spacecraft Soyuz-19 and the American Apollo rendezvoused in orbit, docked, and carried out various experiments and observations, was three years in preparation, requiring extensive and close interaction by both sides. Among other accomplishments the experiment successfully proved the feasibility of docking two space vehicles of different design while in space, for emergency, scientific, or practical purposes. The event was hailed for its revolutionary scientific, economic, and political significance. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N76-32212 California Univ., Los Angeles.
INTERPLANETARY APPROACH OPTICAL NAVIGATION WITH APPLICATIONS Ph.D. Thesis
Navin Jerath 1976 270 p
Avail: Univ. Microfilms Order No. 76-20202

The use of optical data from onboard television cameras for the navigation of interplanetary spacecraft during the planet approach phase is investigated. Three optical data types are investigated: (1) the planet limb with auxiliary celestial references; (2) the satellite-star; and (3) the planet star two camera methods. Analysis and modelling issues related to the nature and information content of the optical methods are examined. Dynamic and measurement system modelling, data sequence design, measurement extraction, model estimation and orbit determination, as relating to optical navigation, have been discussed. The various error sources are analysed. The methodology developed has been applied to the Mariner 9 and the Viking Mars Missions. Navigation accuracies are evaluated at the control and knowledge points, with particular emphasis devoted to the combined use of radio and optical data. Dissert. Abstr.

N76-32213*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER SIMULATION RESULTS OF ATTITUDE ESTIMATION OF EARTH ORBITING SATELLITES
Shanying R. Kou Jul. 1976 58 p refs
(NASA-TM-X-73342) Avail: NTIS HC $4.50 CSCL 22A

Computer simulation results of attitude estimation of Earth-orbiting satellites (including Space Telescope) subjected to

environmental disturbances and noises are presented. Decomposed linear recursive filter and Kalman filter were used as estimation tools. Six programs were developed for this simulation, and all were written in the basic language and were run on HP 9830A and HP 9866A computers. Simulation results show that a decomposed linear recursive filter is accurate in estimation and fast in response time. Furthermore, for higher order systems, this filter has computational advantages (i.e., less integration errors and roundoff errors) over a Kalman filter. Author

N76-32214*# Systems Research Lab., Champaign, Ill.
RESEARCH STUDY ON IPS DIGITAL CONTROLLER DESIGN
Final Report
B. C. Kuo and C. Folkerts 1 Sep. 1976 120 p refs
(Contract NAS8-31570)
(NASA-CR-149992) Avail: NTIS HC $5.50 CSCL 22A

The performance is investigated of the simplified continuous-data model of the Instrument Pointing System (IPS). Although the ultimate objective is to study the digital model of the system, knowledge on the performance of the continuous-data model is important in the sense that the characteristics of the digital system should approach those of the continuous-data system as the sampling period approaches zero. Author

N76-32215*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
DISPERSION ANALYSIS TECHNIQUES WITHIN THE SPACE VEHICLE DYNAMICS SIMULATION PROGRAM
L. S. Snow and A. E. Kuhn 29 Aug. 1975 9 p refs
(Contract NAS9-13970)
(NASA-CR-150969; DN-1.4-7-14) Avail: NTIS HC $3.50 CSCL 22A

The Space Vehicle Dynamics Simulation (SVDS) program was evaluated as a dispersion analysis tool. The Linear Error Analysis (LEA) post processor was examined in detail and simulation techniques relative to conducting a dispersion analysis using the SVDS were considered. The LEA processor is a tool for correlating trajectory dispersion data developed by simulating 3 sigma uncertainties as single error source cases. The processor combines trajectory and performance deviations by a root-sum-square (RSS process) and develops a covariance matrix for the deviations. Results are used in dispersion analyses for the baseline reference and orbiter flight test missions. As a part of this study, LEA results were verified as follows: (A) Hand calculating the RSS data and the elements of the covariance matrix for comparison with the LEA processor computed data. (B) Comparing results with previous error analyses. The LEA comparisons and verification are made at main engine cutoff (MECO). Author

N76-32216*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
EARLIEST ABORT ONCE AROUND TIME FOR THE FIRST ORBITAL FLIGHT TEST MISSION
A. E. Kuhn 26 Sep. 1975 31 p
(Contract NAS9-13970)
(NASA-CR-150970; DN-1.4-7-15) Avail: NTIS HC $4.00 CSCL 22B

The earliest abort once around (AOA) time for the first orbital flight test (OFT-1) mission is determined. The latest estimates of vehicle weights and propulsion for OFT-1 are used. Trade analyses to indicate variations in AOA time for shuttle subsystem changes (such as orbital maneuvering system (OMS) or reaction control system (RCS) propellant loadings) are included. In addition, the effects of first stage attitude steering as a function of relative velocity for a nominal profile are presented. Data are presented to indicate the effect of designing first stage steering for earliest AOA time and then having engine out at times after the design point. Author

N76-32217*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
ABORT-ONCE-AROUND ENTRY DISPERSION CORRIDOR ANALYSIS
H. C. Kyle 31 Jul. 1975 58 p
(Contract NAS9-13970)
(NASA-CR-150971; DN-1.4-4-12) Avail: NTIS HC $4.50 CSCL 22A

Abort-Once-Around (AOA) entry dispersion corridors were determined for Shuttle Mission 3A. These corridors are presented as plots of entry interface flight path angle versus range to target. The methods used to determine the corridors are discussed. Major dispersion sources are discussed and results presented. While specific trajectory inputs and constraints are subject to change, the dispersion corridors show the trends under consideration. The corridors presented show the delta V advantage of the two-burn over the one-burn AOA. The atmospheric dispersion study illustrates the need to target for the seasonal atmosphere. The 40 deg/30 deg angle of attack (alpha) (TPS design) profile did not provide adequate crossrange capability with worst case aerodynamic dispersions. This problem was alleviated with the change to a 38 deg/28 deg alpha profile. The backface temperatures calculated were generally higher than the present limits. Author

N76-32218*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.
ABORT-ONCE-AROUND ENTRY CORRIDOR ANALYSIS PROGRAM DOCUMENT
H. C. Kyle 23 Dec. 1975 42 p refs
(Contract NAS9-13970)
(NASA-CR-150974; DN-1.4-4-17) Avail: NTIS HC $4.00 CSCL 22A

The abort once around entry target corridor analysis program (ABECAP) was studied. The allowable range of flight path angles at entry interface for acceptable entry trajectories from a shuttle abort once around (AOA) situation was established. The solutions thus determined may be shown as corridor plots of entry interface flight path angle versus range from entry interface (EI) to the target. Author

N76-32219*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
RTLS ENTRY LOAD RELIEF PARAMETER OPTIMIZATION
T. J. Crull 27 Jun. 1975 41 p ref
(Contract NAS9-13970)
(NASA-CR-150975; DN-1.4-4-9) Avail: NTIS HC $4.00 CSCL 22A

The results are presented of a study of a candidate load relief control law for use during the pullup phase of Return-to-Launch-Site (RTLS) abort entries. The control law parameters and cycle time which optimized performance of the normal load factor limiting phase (load relief phase) of an RTLS entry are examined. A set of control law gains, a smoothing parameter, and a normal force coefficient curve fit are established which resulted in good load relief performance considering the possible aerodynamic coefficient uncertainties defined. Also, the examination of various guidance cycle times revealed improved load relief performance with decreasing cycle time. A .5 second cycle provided smooth and adequate load relief in the presence of all the aerodynamic uncertainties examined. Author

N76-32220# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
SIX-DEGREE-OF-FREEDOM FLIGHT PATH STUDY GENERALIZED COMPUTER PROGRAM (SDFCP), USER'S MANUAL
Final Report, Jul. 1973 - Jul. 1974
Fay O. Young Jul. 1975 203 p Supersedes AFFDL-TDR-64-1-Pt-2-Vol-1
(AF Proj. 1366)
(AD-A023410; AFFDL-TR-75-1; AFFDL-TDR-64-1-Pt-2-Vol-1) Avail: NTIS CSCL 20/2

Use of the generalized Six-Degree-of-Freedom computer program (SDFCP) is described. With the program, vehicle performance throughout the entire flight regime of speed and altitude in the atmosphere and gravity field of a nonspherical rotating planet using six degrees of freedom may be computed. Various degrees of problem refinement may be analyzed. Flight control systems and flight programmer simulation, and onboard rotating machinery may be represented. Other features of the program include: (1) a reverse program option for aerodynamic analysis of flight test data; and (2) a method of computing aerodynamic derivatives. Author (GRA)

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

N76-32221# ARO, Inc., Arnold Air Force Station, Tenn.
FEASIBILITY STUDY FOR THE USE OF AN ELECTROMAGNETIC RAIL GUN IN THE LAUNCHING AND SUSTAINING OF REENTRY MODELS Final Report, 8 May 1974 - 8 Sep. 1975
John P. Barber (Dayton Univ., Ohio) AEDC Apr. 1976 83 p refs
(ARO Proj. VF419-12GA; ARO Proj. V31S-36A; ARO Proj. V31S-02A)
(AD-A023529; ARO-VKF-TR-75-143; AEDC-TR-76-38) Avail: NTIS CSCL 14/2

The requirements of a realistic reentry test facility for aerothermodynamic tests are reviewed. Basically, this requires the test article to be accelerated to a high velocity and then exposed to the test environment for a sufficient length of time. One method which might be considered to accelerate the test model to the required velocity is an electromagnetic launcher. Equations are developed to describe the performance of several variations of an electromagnetic launcher, as well as component specifications and approximate costs. A similar effort is devoted to the problem of sustaining the velocity by electromagnetically providing a force to overcome the aerodynamic drag and friction forces during testing. Component specifications are developed, and costs are estimated. GRA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N76-32222# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DELTA INTERIM UPPER STAGE SYSTEM STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report, 1 Oct. 1974 - 30 Jun. 1975
R. P. Dawson, J. F. Meyers, R. C. Doiron, and R. G. Monger Jun. 1975 58 p 2 Vol.
(Contract F04701-75-C-0032)
(AD-A021416; MDC-G5973-Vol-1; SAMSO-TR-75-178-Vol-1) Avail: NTIS CSCL 22/2

This study provides DOD with the preliminary design of a Delta IUS system, the identification of IUS/Orbiter and IUS/Spacecraft interfaces, and Delta IUS program definition and costs. The study has shown that with the addition of two inexpensive propellant tanks and other minor stage changes, the basic Delta stage can be easily converted into an IUS stage that can capture all of the DOD and NASA earth orbital missions with ample performance margin (4,820 lb to synchronous orbit). Furthermore, the addition of simple, low-cost auxiliary stages based on existing solid propellant motors, the Delta IUS can capture all of the NASA planetary missions specified. The combinations of IUS elements proposed - the Tri-Tank Family approach - provides the flexibility to select the least expensive IUS suitable for the mission, thus enhancing cost effectiveness. GRA

N76-32223# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DELTA INTERIM UPPER STAGE SYSTEM STUDY. VOLUME 2: TECHNICAL REPORT Final Report, 1 Oct. 1974 - 30 Jun. 1975
R. P. Dawson, J. F. Meyers, R. C. Doiron, and R. G. Monger Jun. 1975 520 p 2 Vol.
(Contract F04701-75-C-0032)
(AD-A021417; MDC-G5973-Vol-2; SAMSO-TR-75-178-Vol-2) Avail: NTIS CSCL 22/2

The Space Shuttle System will require an upper stage (Space Tug, or OOS - Orbit-to-Orbit Shuttle) to achieve maximum effectiveness. A reusable upper stage, although highly desirable, requires a greater initial cash outlay, which would compete for early Shuttle development program funds. Hence, an expendable upper stage, to be used in the interim, has been the subject of various government studies in recent years. This report describes the results of one of these studies, that which addressed the use of Delta launch vehicle hardware to satisfy this requirement. Basic Delta hardware is described, along with the changes which would be required to make it compatible with Shuttle. Both performance and costs are presented, and conclusions drawn. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

N76-32224* National Aeronautics and Space Administration, Washington, D.C.
SHUTTLE ROLL-OUT SET FOR 17 SEPTEMBER 1976
1976 31 p
(NASA-News-Release-76-149; P76-10153) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

The unveiling of the first reusable space shuttle vehicle by the National Aeronautics and Space Administration is discussed. The role of orbiter 101 as a test vehicle is stressed. Approach and landing tests, ground vibration tests, crew are among the topics included. J.M.S.

N76-32225*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
SPACE SHUTTLE THREE MAIN ENGINE RETURN TO LAUNCH SITE ABORT
J. F. Carter and R. L. Bown 21 Nov. 1975 16 p refs
(Contract NAS9-13970)
(NASA-CR-150968; DN-1.4-4-15) Avail: NTIS HC $3.50 CSCL 22A

A Return-to-Launch-Site (RTLS) abort with three Space Shuttle Main Engines (SSME) operational was examined. The results are trajectories and main engine cutoff conditions that are approximately the same as for a two SSME case. Requiring the three SSME solution to match the two SSME abort eliminates additional crew training and is accomplished with negligible software impact. Author

N76-32226*# Aerospace Corp., El Segundo, Calif.
SHUTTLE USER ANALYSIS (STUDY 2.2): VOLUME 3. BUSINESS RISK AND VALUE OF OPERATIONS IN SPACE (BRAVO). PART 4: COMPUTER PROGRAMS AND DATA LOOK-UP
30 Sep. 1974 159 p 4 Vol.
(Contract NASw-2575)
(NASA-CR-148750; ATR-74(7342)-1-Vol-3-Pt-4) Avail: NTIS HC $6.75 CSCL 22B

Computer program listings as well as graphical and tabulated data needed by the analyst to perform a BRAVO analysis were examined. Graphical aid which can be used to determine the earth coverage of satellites in synchronous equatorial orbits was described. A listing for satellite synthesis computer program as well as a sample printout for the DSCS-11 satellite program and a listing of the symbols used in the program were included. The APL language listing for the payload program cost estimating computer program was given. This language is compatible with many of the time sharing remote terminals computers used in the United States. Data on the intelsat communications network was studied. Costs for telecommunications systems leasing, line of sight microwave relay communications systems, submarine telephone cables, and terrestrial power generation systems were also described. Author

N76-32227*# Aerospace Corp., El Segundo, Calif.
SHUTTLE USER ANALYSIS (STUDY 2.2). VOLUME 4: STANDARDIZED SUBSYSTEM MODULES ANALYSIS Final Report
30 Sep. 1974 92 p refs
(Contract NASw-2575)
(NASA-CR-147977; ATR-74(7342)-1-Vol-4) Avail: NTIS HC $5.00 CSCL 22A

The capability to analyze payloads constructed of standardized modules was provided for the planning of future mission models. An inventory of standardized module designs previously obtained was used as a starting point. Some of the conclusions and recommendations are: (1) the two growth factor synthesis methods provide logical configurations for satellite type selection; (2) the recommended method is the one that determines the growth factor as a function of the baseline subsystem weight, since it provides a larger growth factor for small subsystem weights and results in a greater overkill due to standardization; (3) the method that is not recommended is the one that depends upon a subsystem similarity selection, since care must be used in the subsystem similarity selection; (4) it is recommended that the application of standardized subsystem factors be limited to satellites with baseline dry weights between about 700 and 6,500 lbs; and (5) the standardized satellite design approach applies to satellites maintainable in orbit or retrieved for ground maintenance. Y.J.A.

N76-32228# TRW Defense and Space Systems Group, Redondo Beach Calif.
DEPARTMENT OF DEFENSE SPACE TRANSPORTATION SYSTEM MISSION OPERATIONS SYSTEM DEFINITION: COMPUTATIONAL FUNCTION ALLOCATION Final Report, 1 Mar. 1975 - 30 Mar. 1976
K. L. Baker Mar. 1976 204 p refs
(Contract F04701-75-C-0025)
(AD-A022864; TRW-26937-6032-TU-00; SAMSO-TR-76-39) Avail: NTIS CSCL 22/1

The document presents a baseline set of computational functions required by the DOD Mission Operations System and its interfacing systems. These requirements are concerned with the operational use of the Space Shuttle for achieving the DOD mission objectives without determining whether the facilities were under NASA or DOD control. The document addresses the computational function description and allocation, comparison with the NASA computational functions and allocation, external system interfaces, and the security requirements of each facility. GRA

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N76-32229# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
COMPARATIVE EFFECTS OF SIMULATED REENTRY WAKE PLASMA ON THREE BASE-MOUNTED MICROWAVE ANTENNAS Final Report, 1 Oct. 1971 - 30 Nov. 1975
R. L. Bisplinghoff, D. M. Finn, C. W. Haldeman, and T. M. Lawrence Dec. 1975 118 p refs
(Contract F19628-72-C-0022; AF Proj. 2153)
(AD-A022683; TR-192; AFCRL-TR-76-0013) Avail: NTIS CSCL 09/5

The effect of a simulated reentry plasma sheath and ionized wake on three types of base-mounted microwave antennas at 1.2 GHz is discussed. Simulation is produced in the MIT Supersonic Wind Tunnel using a pylon-mounted blunt cone model. Microwave antennas are mounted in the model base, and a dc arc jet inside the model expels plasma from the model nose. This plasma forms a sheath about the nose and expands behind the model to form a plasma-filled wake. This report presents the results of low and high power tests of three base-mounted antenna types: 1/4 wave monopole mast, annular cavity-backed slot and J-slot. The terminal impedance of the mast was affected most by plasma and the cavity-backed slot least. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N76-32230*# Chrysler Corp., New Orleans, La. Space Div.
HEAT TRANSFER TEST OF AN 0.006-SCALE THIN-SKIN THERMOCOUPLE SPACE SHUTTLE MODEL (50-0, 41-T) IN THE NASA-AMES RESEARCH CENTER 3.5-FOOT HYPERSONIC WIND TUNNEL AT MACH 5.3 (IH28), VOLUME 1 Aerothermodynamic Data Report
J. W. Cummings (Rockwell Intern. Corp., Downey, Calif.), T. F. Foster (Rockwell Intern. Corp., Downey, Calif.), and W. K. Lockman (NASA. Ames Research Center) Aug. 1976 836 p refs
(Contract NAS9-13247)
(NASA-CR-147615; DMS-DR-2180-Vol-1) Avail: NTIS HC $21.25 CSCL 22B

Data obtained from a heat transfer test conducted on an 0.006-scale space shuttle orbiter and external tank in the NASA-Ames Research Center 3.5-foot Hypersonic Wind Tunnel are presented. The purpose of this test was to obtain data under simulated return-to-launch-site abort conditions. Configurations tested were integrated orbiter and external tank, orbiter alone, and external tank alone at angles of attack of 0, + or - 30, + or - 60, + or - 90, and + or - 120 degrees. Runs were conducted at Mach numbers of 5.2 and 5.3 for Reynolds numbers of 1.0 and 4.0 million per foot, respectively. Heat transfer data were obtained from 75 orbiter and 75 external tank iron-constantan thermocouples. Author

N76-32231*# Chrysler Corp., New Orleans, La. Space Div.
HEAT TRANSFER OF AN 0.006-SCALE THIN-SKIN THERMOCOUPLE SPACE SHUTTLE MODEL (50-0, 41-T) IN THE NASA-AMES RESEARCH CENTER 3.5-FOOT HYPERSONIC WIND TUNNEL AT MACH 5.3 (IH28), VOLUME 2
J. W. Cummings (Rockwell Intern. Corp., Downey, Calif.), T. F. Foster (Rockwell Intern. Corp., Downey, Calif.), and W. K. Lockman (NASA. Ames Res. Center) Aug. 1976 477 p refs 2 Vol.
(Contract NAS9-13247)
(NASA-CR-147616; DMS-DR-2180-Vol-2) Avail: NTIS HC $12.50 CSCL 22B

For abstract, see preceeding accession.

N76-32232*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.
EPA/ECLSS CONSUMABLES ANALYSES FOR THE SPACELAB 1 FLIGHT
G. J. Steines and M. D. Pipher 20 Sep. 1976 52 p refs
(Contract NAS9-14960)
(NASA-CR-150964) Avail: NTIS HC $4.50 CSCL 22B

The results of electrical power system (EPS) and environmental control/life support system (ECLSS) consumables analyses of the Spacelab 1 mission are presented. The analyses were performed to assess the capability of the orbiter systems to support the proposed mission and to establish the various non propulsive consumables requirements. The EPS analysis was performed using the shuttle electrical power system (SEPS) analysis computer program. The ECLSS analysis was performed using the shuttle environmental consumables requirements evaluation tool (SECRET) program. Author

N76-32233*# Chrysler Corp., New Orleans, La.
SUBSONIC STABILITY AND CONTROL CHARACTERISTICS OF A 0.015-SCALE (REMOTELY CONTROLLED ELEVON) MODEL 44-0 OF THE SPACE SHUTTLE ORBITER TESTED

IN THE NASA/ARC 12-FOOT PRESSURE TUNNEL (LA66)
J. M. Underwood (NASA Johnson Space Center, Houston) and H. Parrell (Rockwell Intern. Space Div.) Sep. 1976 87 p
(Contract NAS9-13247)
(NASA-CR-147621; DMS-DR-2281) Avail: NTIS HC $5.00 CSCL 22B

The investigation was conducted in the NASA/Ames Research Center 12-foot Pressure Tunnel. The model was a Langley-built 0.015-scale SSV orbiter model with remote independently operated left and right elevon surfaces. The objective of the test was to generate a detailed aerodynamic data base for the current shuttle orbiter configuration. Special attention was directed to definition of nonlinear aerodynamic characteristics by taking data at small increments in angle of attack, angle of sideslip, and elevon position. Six-component aerodynamic force and moment and elevon position data were recorded over an angle of attack range from -4 deg to 24 deg at angles of sideslip of 0 deg and + or - 4 deg. Additional tests were made over an angle of sideslip range from -6 deg to 6 deg at selected angles of attack. The test Mach numbers were 0.22 and 0.29 and the Reynolds number was varied from 2.0 to 8.5 million per foot. Author

N76-32234*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS OF AN AIR DATA PROBE INVESTIGATION UTILIZING A 0.10 SCALE ORBITER FOREBODY (MODEL 57-0) IN THE AMES RESEARCH CENTER 14-FOOT WIND TUNNEL (OA220) Aerothermodynamic Data Report
V. Esparza (Rockwell Intern. Corp., Downey, Calif.) and D. E. Thornton (Rockwell Intern. Corp., Downey, Calif.) Sep. 1976 435 p refs
(Contract NAS9-13247)
(NASA-CR-147625; DMS-DR-2286) Avail: NTIS HC $11.75 CSCL 22B

Results are presented of a 0.10 scale orbiter forebody test with left and right mounted air data probes (ADP) as well as a flight test probe (nose boom). Left and right ADP data were obtained at Mach numbers of .3, .4, .5, .6, .7, .8, .85, .9, .95, .98, 1.05 and 1.1 through a Reynolds number range of 1.3 to 4.4 million. Nose boom data were obtained at Mach numbers of .3, .4, .5, .6, .7, .9 and .98. Author

N76-32235*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS OF AN INVESTIGATION TO DETERMINE LOCAL FLOW CHARACTERISTICS AT THE AIR DATA PROBE LOCATIONS USING AN 0.030-SCALE MODEL (45-0) OF THE SPACE SHUTTLE VEHICLE ORBITER CONFIGURATION 140A/B (MODIFIED) IN THE NASA AMES RESEARCH CENTER UNITARY PLAN WIND TUNNEL (OA161, A, B, C), VOLUME 1
M. E. Nichols (Rockwell Intern. Corp., Downey, Calif.) Sep. 1976 769 p ref 2 Vol.
(Contract NAS9-13247)
(NASA-CR-147618; DMS-DR-2245-Vol-1) Avail: NTIS HC $18.75 CSCL 22B

Results are presented of wind tunnel test OA161 of a 0.030-scale model 45-0 of the configuration 140A/B (modified) space shuttle vehicle orbiter in the NASA Ames Research Center Unitary Plan Wind Tunnel facilities. The purpose of this test was to determine local total and static pressure environments for the air data probe locations and relative effectiveness of alternate flight-test probe configurations. Testing was done in the Mach number range from 0.30 to 3.5. Angle of attack was varied from -8 to 25 degrees while sideslip varied between -8 and 8 degrees. Author

N76-32236*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS OF AN INVESTIGATION TO DETERMINE LOCAL FLOW CHARACTERISTICS AT THE AIR DATA PROBE LOCATIONS USING AN 0.030-SCALE MODEL (45-0) OF THE SPACE SHUTTLE VEHICLE ORBITER CONFIGURATION 140A/B (MODIFIED) IN THE NASA AMES RESEARCH CENTER UNITARY PLAN WIND TUNNEL (OA161, A, B, C), VOLUME 2 Aerothermodynamic Data Report
M. E. Nichols (Rockwell Intern. Corp., Downey, Calif.) Sep. 1976 811 p ref
(Contract NAS9-13247)
(NASA-CR-147619; DMS-DR-2245-Vol-2) Avail: NTIS HC $21.25 CSCL 22B
For abstract, see preceding accession.

N76-32237*# Chrysler Corp., New Orleans, La. Space Div.
TERMINAL AREA ENERGY MANAGEMENT REGIME INVESTIGATIONS UTILIZING AN 0.030-SCALE MODEL (47-0) OF THE SPACE SHUTTLE VEHICLE ORBITER CONFIGURATION 140A/B/C/R IN THE AMES RESEARCH CENTER 11 X 11 FOOT TRANSONIC WIND TUNNEL (OH/48)
P. J. Hawthorne (Rockwell Intern. Corp., Downey, Calif.) Jul. 1976 1037 p refs
(Contract NAS9-13247)
(NASA-CR-147603; DMS-DR-2254) Avail: NTIS HC $28.25 CSCL 22B

Data obtained in a wind tunnel test were examined to: (1) obtain pressure distributions, forces and moments over the vehicle 5 Orbiter in the terminal area energy management (TAEM) and approach phases of flight; (2) obtain elevon and rudder hinge moments in the TAEM and approach phases of flight; (3) obtain body flap and elevon loads for verification of loads balancing with integrated pressure distributions; and (4) obtain pressure distributions near the short OMS pods in the high subsonic, transonic and low supersonic Mach number regimes. Testing was conducted over a Mach number range from 0.6 to 1.4 with Reynolds number variations from 7.57 x 1 million to 2.74 x 1 million per foot. Model angle of attack was varied from -4 to 16 degrees and angles of sideslip ranged from -8 to 8 degrees. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N76-32238*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SKYLAB ATM/S-056 X-RAY EVENT ANALYZER: INSTRUMENT DESCRIPTION, PARAMETER DETERMINATION, AND ANALYSIS EXAMPLE (15 JUNE 1973 1B/M3 FLARE)
Robert M. Wilson Aug. 1976 45 p refs
(NASA-TM-X-73332) Avail: NTIS HC $4.00 CSCL 14B

The Skylab ATM/S-056 X-Ray Event Analyzer, part of an X-ray telescope experiment, is described. The techniques employed in the analysis of its data to determine electron temperatures and emission measures are reviewed. The analysis of a sample event - the 15 June 1973 1B/M3 flare - is performed. Comparison of the X-Ray Event Analyzer data with that of the SolRad 9 observations indicates that the X-Ray Event Analyzer accurately monitored the sun's 2.5 to 7.25 A X-ray emission and to a lesser extent the 6.1 to 20 A emission. A mean average peak temperature of 15 million K at 1,412 UT and a mean average peak electron density (assuming a flare volume of 10 to the 13 power cu km) of 27 million/cu mm at 1,416 to 1,417 UT are deduced for the event. The X-Ray Event Analyzer data, having a 2.5 s time resolution, should be invaluable in comparisons with other high-time resolution data (e.g., radio bursts). Author

N76-32239*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.
GENERAL PURPOSE COMPUTER (GPC) TO GPC SYSTEMS INTERFACE DESCRIPTION
B. C. Breyer 20 Sep. 1976 40 p refs
(Contract NAS9-14960)
(NASA-CR-150963; Rept-1.3-DN-C0504-037) Avail: NTIS HC $4.00 CSCL 22B

The General Purpose Computer (GPC) 'subsystem' of the Orbiter Data Processing System was described. Two interface areas are discussed. One is the area of GPC intraconnections and intracommunications involving the hardware/software interface between the Central Processing Unit (CPU) and the Input/Output Processor (IOP). The other is the area of GPC interconnections and intercommunications and involves the hardware/software interface between the five Orbiter GPC's.

Based on the detailed GPC interface given, it is felt that the basic CPU to IOP interface and the GPC to GPC interface have the potential for trouble free operation. However, due to the complexity of the interface and the criticality of GPC synchronization to overall avionics performance, the GPC to GPC interface should be carefully evaluated when attempting to resolve test anomalies that may involve GPC timing and synchronization errors. Author

N76-32240*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.
ERROR ANALYSIS OF THE SHUTTLE REACTION CONTROL SYSTEM PROPELLANT GAGING MODULE
D. D. Duhon 6 May 1975 13 p refs
(Contract NAS9-13970)
(NASA-CR-150966; DN-1.4-2-9) Avail: NTIS HC $3.50 CSCL 22B

An investigation of the Shuttle Reaction Control System (RCS) propellant gaging module has revealed that the gaging errors due to the combined effects of random instrumentation measurement errors and propellant loading uncertainties are non-linear over the range of the propellant quantity gage (0-100%), with the largest error occurring at the zero point. When the RCS propellant tanks are filled to contain 100% of the maximum usable propellant, the largest gaging error was determined to be 3.9% for the fuel and 5.4% for the oxidizer. When the RCS propellant tanks initially contain 50% of the maximum usable propellant, the largest gaging error increases to 4.0% for the fuel and 5.6% for the oxidizer. Author

N76-32241*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.
THE SHUTTLE ORBITAL MANEUVERING SYSTEM P-V-T PROPELLANT QUANTITY GAGING ACCURACY AND LEAK DETECTION ALLOWANCE FOR FOUR INSTRUMENTATION CONDITIONS
D. D. Duhon 23 Jul. 1975 34 p refs
(Contract NAS9-13970)
(NASA-CR-150972; D-1.4-2-12) Avail: NTIS HC $4.00 CSCL 22B

The shuttle orbital maneuvering system (OMS) pressure-volume-temperature (P-V-T) propellant gaging module computes the quantity of usable OMS propellant remaining based on the real gas P-V-T relationship for the propellant tank pressurant, helium. The OMS P-V-T propellant quantity gaging error was determined for four sets of instrumentation configurations and accuracies with the propellant tank operating in the normal constant pressure mode and in the blowdown mode. The instrumentation inaccuracy allowance for propellant leak detection was also computed for these same four sets of instrumentation. These gaging errors and leak detection allowances are presented in tables designed to permit a direct comparison of the effectiveness of the four instrumentation sets. The results show the magnitudes of the improvements in propellant quantity gaging accuracies and propellant leak detection allowances which can be achieved by employing more accurate pressure and temperature instrumentation. Author

N76-32242*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.
RENDEZVOUS RADAR REQUIREMENTS ANALYSIS FOR MISSION 3B
W. L. Hutchison and A. K. Jones 27 Jun. 1975 30 p refs
(Contract NAS9-13970)
(NASA-CR-150973; DN-1.4-3-15) Avail: NTIS HC $3.50 CSCL 22B

Data are presented verifying the compatibility of currently proposed rendezvous radar measurement accuracies with Mission 3B rendezvous requirements. In addition, data presented indicate a potential for increasing the acceptable time lag between termination of thrusting and availability of accurate measurement data. Additional investigation is recommended to define any acceptable time lag above the current proposed value. Finally, Mission 3B rendezvous performance is shown to be sensitive to variations in the relative downrange position dispersions at insertion. It is therefore recommended that insertion relative state dispersions used in studies of 3B rendezvous be reviewed when results of 3B ascent dispersion studies are available. Author

N76-32243*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
CONSOLE TEST REPORT FOR SHUTTLE TASK 501 SHUTTLE CARRIER AIRCRAFT TRANSCEIVER CONSOLE (SED 36115353-301)
J. H. Lane Aug. 1976 44 p ref
(Contract NAS9-12200)
(NASA-CR-150986; LEC-9352; JSC-11587) Avail: NTIS HC $4.00 CSCL 22B

Performance tests completed on the Space Shuttle Carrier Aircraft (SCA) transceiver console, verifying its design objectives, were described. These tests included: (1) check of power supply voltages for correct output voltage and energization at the proper point in the turn on sequence, (2) check of cooling system (LRU blower, overload sensors and circuitry, and thermocouple probe), (3) check of control circuits logic, including the provisions for remote control and display, (4) check of the LRU connector for presence of correct voltages and absence of incorrect voltages under both energized and deenergized conditions, and (5) check of the AGC and power output monitor circuits. Y.J.A.

N76-32400 Fairchild Space and Electronics Co., Germantown, Md.
PERFORMANCE OF HEAT PIPE ROTATING ABOUT THE VERTICAL AXIS AND ITS APPLICATION TO A SPINNING SPACECRAFT
Han Hwangbo, Robert J. Eby, and Robert S. Rovinski (NRL) *In* ESA Heat Pipes 1976 p 315-324 refs (For availability see N76-32374 23-31)

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N76-32244*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL RESEARCH IN THE USE OF ELECTRETS IN MEASURING EFFLUENTS FROM ROCKET EXHAUST AND A REVIEW OF STANDARD AIR QUALITY MEASURING DEVICES
Michael Susko Aug. 1976 27 p refs
(NASA-TM-X-73327) Avail: NTIS HC $4.00 CSCL 14B

Seven standard types of measuring devices used to obtain the chemical composition of rocket exhaust effluents were discussed. The electrets, a new measuring device, are investigated and compared with established measuring techniques. The preliminary results obtained show that electrets have multipollutant measuring capabilities, simplicity of deployment, speed of assessment or analysis, and may be an important and valuable tool in measuring pollutants from space vehicle rocket exhaust. Author

N76-32245# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
AN ASSESSMENT OF THE NASA BAND MODEL FORMULATION FOR CALCULATING THE RADIANCE AND TRANSMISSION OF HOT AND COOL GASES Technical Report, 1 Jul. - 30 Dec. 1975
Peter C. Sukanek and Larry P. Davis Feb. 1976 50 p refs
(AF Proj. 5730)
(AD-A023138; AFRPL-TR-76-9) Avail: NTIS CSCL 21/5

The NASA band model formulation for calculating the radiance and transmission of gases is evaluated by comparing its predictions to laboratory data on H2O, CO2, and various mixtures containing these gases. The calculations reproduce the measured values for homogeneous and inhomogeneous samples of H2O to within about + or - 20%. The agreement with measured

values for CO2 was not as good, especially at low pressures. The theoretically derived band model parameters for CO2 appear to be in error. For mixtures of H2O, CO2 and other gases (N2, CO, H2), the agreement was good. Author (GRA)

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N76-32246# Massachusetts Univ., Amherst. Dept. of Chemical Engineering.
IMMOBILIZATION OF CATALASE AND GLUCOSE OXIDASE ON INORGANIC SUPPORTS
Peter E. Markey, Paul F. Greenfield, and J. R. Kittrell Jun. 1974 12 p refs
(Grant NSF GI-34976)
(PB-252609/3; NSF/RA/T-74-145) Avail: NTIS HC $3.50 CSCL 07C

Glucose oxidase and catalase were individually immobilized on several inorganic supports using the glutaraldehyde procedure. Enzymic activity depended on the support type and the particle size of the support used in the assay. The least expensive supports exhibited the highest activity for both small and large particle sizes. A number of inorganic supports were screened, for use in industrial immobilized enzyme reactors. Consequently emphasis was placed on determining the initial activity of the catalysts rather than on determining the efficiency of the immobilization procedure. Author (GRA)

N76-32247# Massachusetts Univ., Amherst.
STUDIES OF A CATALYTIC REACTOR USING AN IMMOBILIZED MULTI-ENZYME SYSTEM Technical Report, 1 Jan. 1975 - 29 Feb. 1976
H. O. Hultin, J. R. Kittrell, and R. L. Laurence Mar. 1976 48 p refs
(Grant NSF GI-34976)
(PB-252452/8; NSF/RA-760056) Avail: NTIS HC $4.00 CSCL 07C

The primary objective of the University of Massachusetts Enzyme Group is to understand and develop techniques useful for providing immobilized multi-enzymes of high activity and stability and to make accurate engineering evaluations of their performance in flow reactors. The use of glucose oxidase (GOx) and catalase as model enzymes is well suited to reach these objectives since they exhibit many efficiency and stability characteristics important to a broad range of enzymic systems. In order to improve the loading capacity of silica alumina and natural clay supports, work has been carried out to cross-link the soluble enzyme to itself before binding the enzyme to the support. It was found that catalase can be cross-linked readily with glutaraldehyde, while glucose oxidase could be cross-linked only at very high concentrations of enzyme and glutaraldehyde or if another protein such as bovine serum albumin was present. GRA

N76-32248# Battelle Columbus Labs., Ohio. Metals and Ceramics Information Center.
HANDBOOK ON MATERIALS FOR SUPERCONDUCTING MACHINERY. MECHANICAL, THERMAL, ELECTRICAL, AND MAGNETIC PROPERTIES OF STRUCTURAL MATERIALS INCLUDING DATA SHEETS FOR THE FIRST SUPPLEMENT Technical Report, Nov. 1974 - Nov. 1975
K. R. Hanby Nov. 1975 278 p refs
(Contract NBS-CST-8303; ARPA Order 2569)
(AD-A023228; MCIC-HB-04S1) Avail: NTIS CSCL 11/6

The major objective of this supplement, as for the Handbook, is to present data that could be used effectively in the development of new concepts in superconducting machinery. Information was collected on the mechanical, thermal, electrical, and magnetic properties of selected structural materials for designers and users of equipment that will be exposed to cryogenic temperatures. The data are presented as 'best value' numbers from compilations of data in the temperature range 0 to 300K. Materials for inclusion in this Handbook include the following classes of metals and alloys: Aluminum and aluminum alloys, Copper and copper alloys, Nickel alloys, Alloy steels, Stainless steels, Titanium and titanium alloys, Niobium and alloys, and Polymers. GRA

N76-32249# Virginia Univ., Charlottesville. Dept. of Chemistry.
COBALT-HYDROGEN METALLOCARBORANES. SYNTHESIS OF CLOSO-[(CH3)2C2B4H4]2CoH AND NIDO-CLOSO-[(CH3)2C2B3H5]CoH[(CH3) 2C2B4H4] AND THEIR CONVERSION TO NEW COBALT-COBALT BONDED METALLOCARBORANES Interim Technical Report
William M. Maxwell, Vernon R. Miller, and Russell N. Grimes Feb. 1976 39 p refs
(Contract N00014-75-C-0305; NR Proj. 053-569)
(AD-A022758; TR-20) Avail: NTIS CSCL 07/3

The reaction of Na(+)((CH3)2C2B4H5)(-) with CoCl2 at 25C yields the red neutral commo-metallocarborane (C,C'-(CH3) 2C2B4H4)2Co(III)H. From NMR evidence the hydrogen atom associated with the metal is proposed to be face-bonded to a triangular face on the polyhedral surface. The compound is converted in aqueous acid to a nido-closo species, (C,C'-(CH3) 2C2B3H5)CoH(C,C'-(CH3)2C2B4H4), which in turn can be metal-deprotonated by NaH to give the ((CH3)2C2B3H5)Co((CH3) 2C2B4H4)(-) ion; reaction of the latter species with aqueous HCl regenerates the neutral metal-protonated compound. The reaction of the ion with CoCl2 and NaC5H5 produces nido-closo ((CH3)2C2B3H5)CoH((CH3)2C2B3H3)Co(eta to the 5th power-C5H5) in which a Co-Co bond is postulated. Treatment of (C,C'-(CH3)2C2B4H4)2Co(III)H with (eta to the 5th power-C5H5)Co(CO)2 yields 4,5 (CH3)2-1,2,4,5-(eta to the 5th power-C5H5)2Co2C2B3H3 and (eta to the 5th power-C5H5)Co ((CH3)2C2B3H3)CoH((CH3)2C2B3H3)Co(eta to the 5th power-C5H5), the latter species having a proposed Co-Co link. Air-oxidation of (C,C'-(CH3)2C2B4H4)2Co(III)H produces the tetracarbon carborane (CH3)4C4B8H8. GRA

24 COMPOSITE MATERIALS

Includes laminates.

N76-32250*# Avco Corp., Lowell, Mass. Systems Div.
A STUDY TO IMPROVE THE MECHANICAL PROPERTIES OF SILICON CARBIDE RIBBON FIBERS Technical Report, 22 Mar. 1974 - 1 Apr. 1976
Harold E. DeBolt and Raymond J. Robey 15 Aug. 1976 50 p refs
(Contract NAS1-13018)
(NASA-CR-145033) Avail: NTIS HC $4.00 CSCL 11D

Preliminary deposition studies of SiC ribbon on a carbon ribbon substrate showed that the dominant strength limiting flaws were at the substrate surface. Procedures for making the carbon ribbon substrate from polyimide film were improved, providing lengths up to 450 meters (1,500 ft.) of flat carbon ribbon substrate 1,900 microns (75 mils) wide by 25 microns (1 mil) thick. The flaws on the carbon ribbon were smaller and less frequent than on carbon ribbon used earlier. SiC ribbon made using the improved substrate, including a layer of pyrolytic graphite to reduce further the severity of substrate surface flaws, showed strength levels up to the 2,068 MPa (300 Ksi) target of the program, with average strength levels over 1,700 MPa (250 Ksi) with coefficient of variation as low as 10% for some runs. Author

N76-32251*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
IMPACT OF COMPOSITE PLATES: ANALYSIS OF STRESSES AND FORCES Final Report, May 1974 - Aug. 1975
F. C. Moon, B. S. Kim, and S. R. Fang-Landau Jan. 1976 111 p refs
(Grant NGR-31-001-267)
(NASA-CR-134999; AMS-1298) Avail: NTIS HC $5.50 CSCL 11D

The foreign object damage resistance of composite fan blades was studied. Edge impact stresses in an anisotropic plate were first calculated incorporating a constrained layer damping model. It is shown that a very thin damping layer can dramatically

decrease the maximum normal impact stresses. A multilayer model of a composite plate is then presented which allows computation of the interlaminar normal and shear stresses. Results are presented for the stresses due to a line impact load normal to the plane of a composite plate. It is shown that significant interlaminar tensile stresses can develop during impact. A computer code was developed for this problem using the fast Fourier transform. A marker and cell computer code were also used to investigate the hydrodynamic impact of a fluid slug against a wall or turbine blade. Application of fluid modeling of bird impact is reviewed. Author

N76-32252# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
THE INFLUENCE OF FIBRE DISTRIBUTION ON THE MODULI OF UNIDIRECTIONAL FIBRE REINFORCED COMPOSITES
E. H. Mansfield London Aeron. Res. Council 1976 40 p refs Supersedes RAE-TR-74182; ARC-36140
(ARC-CP-1347; RAE-TR-74182; ARC-36140) Avail: NTIS HC $4.00; HMSO £1.80; PHI

Theoretical analyses were made of the influence of the following features on the longitudinal shear and transverse tensile moduli of unidirectional fiber reinforced composites: (1) random variations in positioning of individual fibers, (2) overall variations leading to fiber bunching, (3) overall variations leading to interspersed matrix layers, and (4) localized variations resulting in matrix pockets. The degree to which these features occur in carbon fiber reinforced plastics is considered, and observed discrepancies between measured values of the moduli and theoretical predictions assuming a regular hexagonal array are explained. Author (ESA)

N76-32253# Martin Marietta Labs., Baltimore, Md.
THE PREPARATION OF TITANIUM-VANADIUM CARBIDE-NICKEL CERMETS
Walter Precht and Bernard Prissler Jan. 1976 29 p refs
(Grant NSF APR-74-21441)
(PB-252596/2; MML-TR-76-05c; NSF/RA-760019) Avail: NTIS HC $4.00 CSCL 11D

Titanium/vanadium alloy carbide rods were prepared by a zone melting procedure. Wetting studies were carried out using sections of the fused rods and candidate matrix material. It was established that nickel exhibits excellent wetting of (Ti, V) C, and accordingly cermet blends were prepared and liquid phase sintered. Processing parameters are discussed as well as their effect on the final microstructure. Alternate methods for cermet preparation are offered which use as received titanium carbide and vanadium carbide powders. GRA

N76-32254# Martin Marietta Labs., Baltimore, Md.
A SIMPLE METHOD FOR EVALUATING CEMENTED CARBIDES
R. K. Viswanadham and J. D. Venables Jan. 1976 25 p refs
(Grant NSF APR-74-21441)
(PB-252595/4; MML-TR-75-44c; NSF/RA-760018) Avail: NTIS HC $3.50 CSCL 11D

A simple method is proposed whereby meaningful comparisons can be made between the mechanical properties of cermet cutting tool materials such as (WC-Co) and (Ti,V) C-Ni. It is shown experimentally and analytically that the parameters measured by the Palmqvist test, the crack resistance parameter, W, (which is shown to be linearly related to the critical strain energy release rate G sub IC) and the hardness, H, are related by the following expression $1/W = AH - B$ where A and B are constants. The significance of this result is that it can be employed to quickly classify experimental carbide/binder combinations according to their potential as cutting tool materials having both high hardness and good resistance to impact. GRA

N76-32255# Martin Marietta Labs., Baltimore, Md.
CEMENTED ALLOY CARBIDES FOR HARD ROCK BORING Six Month Report No. 3, 1 Oct. 1975 - 31 Mar. 1976
J. A. S. Green, J. D. Venables, R. K. Viswanadham, and W. Precht Mar. 1976 36 p ref
(Grant NSF APR-74-21441)
(PB-252359/5; MML-TR-76-20C; NSF/RA-760047) Avail: NTIS HC $4.00 CSCL 11K

The results are presented of work in progress to determine whether newly developed ordered alloy carbides can provide significant improvements in the performance of cutting tool materials used in the hard rock boring industry. The effort has focussed on evaluating the properties of materials fabricated in the project and comparing them with those of conventional WC + Co. For this purpose, a new test procedure was devised that appears to have distinct advantages over more conventional test procedures. A Panel Review meeting was convened with the purpose of eliciting guidance from industry and government representatives regarding the project and its future course. A summary of the meeting and the modifications made in the project as a result of the Panel's recommendations are discussed. GRA

N76-32256# Alabama Univ., Huntsville. School of Graduate Studies and Research.
TEMPERATURE SENSITIVE DYNAMIC CUSHIONING FUNCTION DEVELOPMENT AND VALIDATION FOR BLOCKSOM RUBBERIZED HAIR Final Technical Report, 1 Dec. 1974 - 30 Jun. 1975
Richard M. Wyskida, Mickey R. Wilhelm, and Joseph D. Bynum Jul. 1975 139 p
(Contract DAAH01-75-C-0113)
(AD-A023219; UAH-RR-172; RL-CR-75-4) Avail: NTIS CSCL 11/10

After acquisition of drop test data on the cushioning performance of Type V Rubberized Hair, an Analysis of Variance (ANOVA) was conducted which was based upon the split-split plot experimental design to establish the statistical significance of the temperature effect. This, of course, means that it is possible to reject the null hypothesis that temperature has no effect upon cushioning performance of this material for all four drop heights. After the temperature effect was proven significant, the data was input to the curvilinear regression computer program. Once again, the parabolic-logarithmic fit was determined to be best for predicting the deceleration at impact of a packaged item. GRA

N76-32257# Texas A&M Univ., College Station. Mechanics and Materials Research Center.
SOME VISCOELASTIC CRACK GROWTH RELATIONS FOR ORTHOTROPIC AND PRESTRAINED MEDIA Interim Report
G. S. Brockway and R. A. Schapery Oct. 1975 44 p refs
(Grant AF-AFOSR-2697-74; AF Proj. 9782)
(AD-A023048; MM-3064-75-3; AFOSR-76-0296TR) Avail: NTIS CSCL 11/4

Equations are developed for predicting opening and sliding modes of crack growth along planes of geometric symmetry in viscoelastic orthotropic media with and without large prestrains. Except for the small zone of failing material at the crack tip, the body is assumed to be linearly viscoelastic with respect to the changes in stress and strain which occur during crack propagation. Results obtained previously for isotropic media are first reviewed, and then a relation is derived for predicting crack tip velocity in an orthotropic body in plane strain; included is a numerical example using constitutive properties of a fiber-reinforced plastic. Extension to fracture of prestrained media and crack growth between certain types of dissimilar media is then made. Finally, it is argued that these crack velocity relations can be employed in plane stress problems and in many three-dimensional cases, and, with a small change, can be used to predict the time of fracture initiation. Author (GRA)

N76-32258# ECP, Inc., Los Angeles, Calif.
DEVELOPMENT OF A FOAMED GLASS POWER POLE DERIVED FROM FLY ASH Final Report
Tudor Williams Apr. 1976 142 p
(PB-252940/2; EPRI/TD-126) Avail: NTIS HC $6.00 CSCL 11D

The results of a ten month research activity designed to validate the physical parameters and economics of a power pole made from foamed glass were presented. Results indicate that a 18.28 m (60 ft.) class 1 power pole could be made from foamed glass with fly ash filler for about $77 in a 199,000 kg 220 ton a day glass facility. The foam glass with fly ash filler exhibited strengths in large samples of 3,448 N/sq cm to

4137 N/sq cm (5,000 to 6,000 psi) for densities of 2.0 - 2.3 gm/cc and impact resistance equal to or greater than concrete or brick. Analysis of the pole design revealed that a hollow circular pole would be best suited for both load carrying and cross arm attachment. Author (GRA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N76-32259 Kentucky Univ., Lexington.
INORGANIC CRYSTALLIZATION CHROMATOGRAPHY Ph.D. Thesis
John Preston Miles, III 1976 177 p
Avail: Univ. Microfilms Order No. 76-20163

Crystallization chromatography was applied to inorganic mixtures, the requirements and characteristics of the technique were identified, and examples of the separation produced were investigated. A glass column filled with a bed of small diameter glass beads and clamped in an aluminum cylinder was used. The top of the column was heated with two heating tapes and the bottom cooled by circulating coolant from an external cooling source. Flow was controlled with a peristaltic pump, and effluent fractions were collected with a linear fraction collector. Analysis of metal content of fractions was performed by flame atomic absorption or emission techniques. Separations of rare earth oxalates and alkaline earth sulfates with EDTA elution gradients were attempted, and Cd, Zn, and Cu hydroxides were investigated using pH elution. Dissert. Abstr.

N76-32260 North Carolina Univ., Chapel Hill.
FEATURE SELECTION AND DIMENSIONALITY REDUCTION IN PATTERN RECOGNITION ON CHEMICAL DATA Ph.D. Thesis
Stephen Ralph Lowry 1975 146 p
Avail: Univ. Microfilms Order No. 76-20053

The feature selection step in pattern recognition of chemical data is stipulated. Methods of calculating the important parameters in several types of chemical data are described. Feature selection techniques for three different data sets are described. The first is mass spectral data. Two methods are reported for reducing the number of m/e positions required to classify compounds from their mass spectrum. One method is a filter network in which the important mass positions are investigated individually and a decision made after each observation. The other uses the correlation effects between mass positions to replace two mass positions with a single second order term. This not only reduces the number of dimensions in the data but also incorporates the important second order effects found in mass spectra. The second area concerns infrared data. Two techniques have been developed for feature selection of binary infrared spectra. Dissert. Abstr.

N76-32261 Purdue Univ., Lafayette, Ind.
ISOTOPIC RATIOS AS A SELECTIVE REQUIREMENT FOR MASS FRAGMENTOGRAPHY Ph.D. Thesis
David Charles Canada 1973 178 p
Avail: Univ. Microfilms Order No. 76-21078

A gas chromatograph mass spectrometer computer data system has been developed to handle isotope based mass fragmentography. Major processing of the mass spectrometer data is done on a time-shared 108 K PDP-11/45 computer. Data reduction and gas chromatograph mass spectrometer control logic is done on a dedicated on line 4K PDP-11/15 satellite computer. During the time course of a gas chromatographic analysis, the mass spectrometer scans spectra in a repetitive fashion. The reduced data is stored on a disk at the time shared computer center for further processing. Other ancillary software has been written to subtract background spectra, plot individual spectra, print individual spectra as a matrix, plot total ion current and match unknown spectra to standard library spectra. Dissert. Abstr.

N76-32262 Purdue Univ., Lafayette, Ind.
INTEGRAL REFLECTION SPECTROSCOPY FOR THE STUDY OF SURFACE ADSORPTION ON THIN METAL FILMS-INSTRUMENTATION AND METHODOLOGY Ph.D. Thesis
Joe Henry Cary 1975 284 p
Avail: Univ. Microfilms Order No. 76-21091

The applicability of internal reflection spectroscopy to the study of surface adsorption on thin metal film electrodes was investigated. The specific system studied was the electrochemical oxidation of platinum thin films. A dual beam internal reflection spectrometer was built which is capable of taking reflection absorbance vs. angle data under computer control over a range of wavelengths. This spectrometer is also capable of detecting absorbance changes due to surface adsorption as small as .0005 absorbance units. Methods were developed to deposit thin metal films using cathodic sputtering, and a titanium undercoat was used to greatly improve the adhesion of the platinum films to a glass prism substrate. These films could withstand very vigorous electrochemical conditions. Curve-fitting programs were written to calculate the optical constants and thicknesses of the metal films. Dissert. Abstr.

N76-32263 Purdue Univ., Lafayette, Ind.
SPECTROELECTROCHEMICAL AND X-RAY PHOTOELECTRON SPECTROSCOPIC STUDIES OF PORPHYRINS AND RELATED COMPOUNDS Ph.D. Thesis
Dale Herbert Karweik 1975 216 p
Avail: Univ. Microfilms Order No. 76-20457

X-ray photoelectron spectroscopy was applied to the structural study of porphyrins. The N 1s, and C 1s binding energies of the free base compounds (H2OEP, H2TrP, H2TPP, H2TPC, H2TPBC), the metalloporphyrins, (MgTPP, ZnTPP, CoTPP, CuTPP, NiTPP, AgTPP, AgOEP), the metallochlorins (MgTPC, ZnTPC, CoTPC, CuTPC, NiTPC, AgTPC) and the oxidation products (AgOEP(+)CLO4(-)) are reported. The N is binding energies plus additional information from theoretical calculations, NMR, UV-VIS, and IR spectroscopy show that reduction of the ligand introduces an electron withdrawing group into the ligand which only subtly changes the free base spectra. The replacement of the free base protons by a metal ion to form the metalloporphyrin increases the symmetry of the molecule and also introduces an electron withdrawing group into the center of the ligand which increases the N 1s binding energy as the metal ion electronegativity increases. Finally, these results are used to show that both effects are found in metallochlorins. Dissert. Abstr.

N76-32264 State Univ. of New York, Albany.
THE REACTIVITY OF TIN (2) AND TIN (4)-OXYGEN COMPOUNDS Ph.D. Thesis
William D. Honnick 1976 306 p
Avail: Univ. Microfilms Order No. 76-19287

Organotin(2) and tin(4) compounds containing tin-oxygen bonds are useful reagents in the synthesis of organotin compounds. The reactions of tin(2) dimethoxide and diorganotin oxides with various reagents were studied and the products characterized by infrared, tin-119m Moessbauer, proton, and carbon-13 nmr spectroscopies. Dissert. Abstr.

N76-32265 Purdue Univ., Lafayette, Ind.
CHRONOAMPEROMETRIC STUDY OF RAPID PROCESSES FOLLOWING FLASH PHOTOLYSIS Ph.D. Thesis
Keith Francis Dahnke 1975 295 p
Avail: Univ. Microfilms Order No. 76-20442

Electrochemical measurements have been used in connection with the flash photolysis technique to study very rapid photolytic reactions in solution. Advances in instrumentation and theory have allowed the study of benzophenone photodimerization in acidic and basic solution. The use of minicomputer data acquisition and handling greatly enhanced the volume and type of data which could be obtained. A theoretical model describing the effect of faradaic induced charging current was verified. A more flexible method involves direct application of the differential equation relating induced charging currents to the faradaic current and measured total current. Results similar to those obtained with the previous method were obtained for known electrode

processes. A digital simulation approach was developed which can be applied to any coupled kinetic-diffusion mechanism.
Dissert. Abstr.

N76-32266 Wisconsin Univ., Milwaukee.
ANALYTICAL APPLICATIONS OF CHEMICAL INHIBITION IN FLAME SPECTROSCOPY Ph.D. Thesis
James Richard Sand 1975 143 p
Avail: Univ. Microfilms Order No. 76-19348

The desirability of applying the simplicity inherent in calcium emission flame spectroscopy to investigations on anion flame inhibition effects, was discussed. Changes in instrumental design were made to take advantage of the decreased spectral resolution and increased optical efficiencies required by the method. The unusual shapes of these - titration curves - appear to result from complicated processes occurring in the evaporating droplets of sample formed by the burner nebulization process. Direct correlations are made between features of the titration curves and sample anion concentrations. These correlations are used to analyze a variety of real samples for silica and sulfate. Results of such analyses compare favorably to more cumbersome established procedures. Increasing detection efficiency and decreasing noise permitted measurements of sulfate at the 0.20 ppm level with a precision superior to that of conventional methods. Studies indicate the other commonly found anions do not constitute interferences for these techniques. Dissert. Abstr.

N76-32267 Georgia Inst. of Tech., Atlanta.
IGNITION CHARACTERISTICS OF A COMBUSTIBLE MIXTURE IN OPPOSED FLOW WITH A HOT INERT GAS Ph.D. Thesis
Heng-Wai Hsu 1976 92 p
Avail: Univ. Microfilms Order No. 76-21209

The heat interaction and ignition characteristics of a cold combustible mixture in opposed flow with a hot inert gas near the stagnation region is considered. An axisymmetric jet impinging on a constant temperature wall with inert gas being injected through the porous wall is investigated. An axisymmetric jet of combustible mixture is opposed by another jet of hot, inert gas. The analysis is carried out for compressible flow. A second order Arrhenius law is assumed to describe the chemical kinetics of the mixture. The boundary layer equations are solved numerically to investigate the effects of the inert gas injection rate in the impinging jet case and the hot gas temperature in the opposed jet case on the ignition and flow parameters. Dissert. Abstr.

N76-32268 Princeton Univ., N.J.
ANALYSIS OF DISTRIBUTED CHEMICAL REACTION SYSTEMS Ph.D. Thesis
Yue Kwang Yang 1973 214 p
Avail: Univ. Microfilms Order No. 76-20345

Theoretical investigations of the dynamic and steady state behaviors of a single porous catalyst particle either with coupled intraparticle interphase transport or with intraparticle transport only were presented. Techniques as well as functional relations which enable effective application of Lyapunov's direct method to some special kinds of infinite dimensional system having Dirichlet or Neumann type boundary conditon were developed and applied to the analysis of the stability of such a catalyst particle. A number of stability criteria were discussed. The transient response of a one dimensional porous catalyst slab was studied numerically by means of an efficient computational algorithm which combines Saulyev's explicit formulas for parabolic partial differential equations with a predictor-corrector scheme for the nonlinear term. Dissert. Abstr.

N76-32269 Princeton Univ., N.J.
MULTICOMPONENT KINETIC ANALYSIS OF CHEMICAL REACTION SYSTEMS WITH DIFFUSION Ph.D. Thesis
Shi-Ping Ho 1975 266 p
Avail: Univ. Microfilms Order No. 76-20364

The problem of the kinetics of coupled systems of chemical reactions involving many species in which diffusion plays a significant role was investigated. A general class of multicomponent diffusion reaction systems and, in particular, systems of first order consecutive reactions, was discussed. An attempt was made to develop analytical methods for calculating the concentrations and the reaction rates as a function of system parameters. Special emphasis was placed on the kinetic analysis of immobilized multienzyme systems. The applications of such systems to the modeling of reactors using enzymes were considered.
Dissert. Abstr.

N76-32270 City Univ. of New York.
DEFLUIDIZATION PHENOMENA IN FLUIDIZED BEDS OF STICKY PARTICLES AT HIGH TEMPERATURES Ph.D. Thesis
Jeffrey Howard Siegell 1976 163 p
Avail: Univ. Microfilms Order No. 76-19683

Defluidization limits were determined for metallic, polymeric and coal ash particle systems. Excess velocity, above the minimum necessary to maintain fluidization was studied as a function of temperature and particle size. A dilatometer test was developed for the determination of the defluidization temperature of an incipiently fluidized bed. This corresponds to the temperature at which the particles begin to sinter at an appreciable rate. Photographs and micrographs of multi-particle agglomerates are presented along with a discussion of the results of high speed photographic studies of an agglomerating bed. A simplistic model based on the fluidization and sintering parameters of the particles is proposed to explain the defluidization phenomena.
Dissert. Abstr.

N76-32271# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
THE INFLUENCE OF PRESSURE ON COMBUSTION INTENSITY
H. A. Arbib, Y. Goldman, and Y. Manheimer-Timnat Jun. 1976 27 p refs
(TAE-287) Avail: NTIS HC $4.00

The influence of pressure on the processes occurring in the combustion chamber is studied. The aim is to reduce its dimensions without altering its efficiency. Author

N76-32272*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABLES AND CHARTS OF EQUILIBRIUM THERMODYNAMIC PROPERTIES OF CARBON DIOXIDE FOR TEMPERATURES FROM 100 K TO 25,000 K
Charles G. Miller, III and Sue E. Wilder 1976 493 p refs
(NASA-SP-3097) Avail: NTIS HC $11.50 CSCL 07D

Equilibrium thermodynamic properties for pure carbon dioxide are presented in tabulated and graphical form for temperatures from 100 K to 25,000 K and pressures from 40 mN/sq m to 1 GN/sq m. Properties include pressure, temperature, density, enthalpy, speed of sound, entropy, molecular weight ratio, specific heat at constant pressure, specific heat at constant volume, isentropic exponent, and species mole fractions. Author

N76-32273# Rock Island Arsenal, Ill. General Thomas J. Rodman Lab.
APPLICATION OF ATOMIC ABSORPTION SPECTROPHOTOMETRIC TECHNIQUES TO THE ANALYSIS OF COPPER-BASE ALLOYS Technical Report, Nov. 1973 - Jun. 1974
Elizabeth A. Peterson Mar. 1975 27 p refs
(AD-A023457; RIA-R-TR-75-012) Avail: NTIS CSCL 07/4

A simplified method of analysis for the determination of manganese, copper, zinc, iron, nickel, aluminum and tin in copper-base alloys has been developed in which a single dissolution of the sample is used. Results of repeated determinations on secondary standards prepared at this laboratory and on National Bureau of Standards (NBS) reference materials in which aqueous standard solutions were used were in good agreement with accepted values. GRA

N76-32274# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
SELECTED TABLES OF ATOMIC SPECTRA. ATOMIC ENERGY LEVELS AND MULTIPLET TABLES O I
Charlotte E. Moore Apr. 1976 33 p
(PB-253231/5; NSRDS-NBS-3-Sect-7; LC-64-600074) Avail: NTIS HC $4.00 CSCL 07D

Part A contains the atomic energy levels and Part B the multiplet tables. Section 7 presents this material for the first spectrum of oxygen, O I. GRA

N76-32275# National Bureau of Standards, Washington, D.C.
THE 4f EXCITATION ENERGIES IN RARE-EARTH METALS: RELATIVISTIC CALCULATIONS Final Report
J. F. Herbst, R. E. Watson (Brookhaven Natl. Lab.), and J. W. Wilkins (Cornell Univ., Ithaca, N. Y.) 22 Oct. 1975 9 p Repr. from Physical Review B, vol. 13, no. 4, 15 Feb. 1976 p 1439-1445 Sponsored in part by ERDA
(Grant NSF DMR-74-23494)
(PB-252727/3) Avail: NTIS HC $3.50 CSCL 07D

Relativistic Hartree-Fock calculations for atomic configurations most closely approximating those of the metals are initially performed, and crystal potentials are constructed by means of the renormalized-atom method. Relativistic band calculations are iterated to crude self-consistency and total band energies obtained. Correlation effects identical to those in the free atoms are assumed. Within the assumption of a completely screened final state, in which the atomic site having the 4f hole is electrically neutral, 4f binding energies are estimated which are in at least as good agreement with experiment as previous, less complete calculations. GRA

N76-32276# National Bureau of Standards, Washington, D.C. Optical Physics Div.
PHOTOABSORPTION OF THE 4d ELECTRONS IN XENON AND BARIUM: A COMPARISON Final Report
D. L. Ederer, T. B. Lucatorto, E. B. Saloman, R. P. Madden, and M. Manalis 1976 15 p refs Repr. from Proceedings of the Intern. Symp. on Electron and Photon Interactions with Atoms, Stirling, Scotland, 16-19 Jul. 1974 p 69-81
(PB-252723/2) Avail: NTIS HC $3.50 CSCL 07D

The 4d absorption spectra of xenon and barium show very different behavior. In xenon the cross section was measured for two series of resonances converging to the 4d(9) (Doublet D(5/2),(3/2)) limit. By a parameterization technique, the amplitudes and widths of these resonances were obtained. The barium spectrum is very different from the xenon spectrum because the 4f orbital contracts in excited barium and overlaps the 4d orbit. GRA

N76-32277# National Bureau of Standards, Washington, D.C.
LASER-EXCITED RAMAN SPECTROSCOPY FOR NON-DESTRUCTIVE PARTIAL ANALYSIS OF INDIVIDUAL PHASES IN FLUID INCLUSIONS IN MINERALS
Gregory J. Rosasco, Edwin Roedder, and Joseph H. Simmons Nov. 1975 5 p refs Repr. from Science, vol. 190, 7 Nov. 1975 p 557-560 Prepared in cooperation with Geological Survey, Reston, Va.
(PB-253263/8) Avail: NTIS HC $3.50 CSCL 08G

Laser excited Raman spectroscopy was successfully applied to the identification and partial analysis of solid, liquid, and gaseous phases in fluid inclusions. The measurement was performed in situ, it was nondestructive, and it can produce qualitative and quantitative data, some of which cannot be obtained otherwise, for samples as small as 10 to the -9th power gram.
Author (GRA)

N76-32278# California Univ., Berkeley. Dept. of Mechanical Engineering.
NONEQUILIBRIUM COMBUSTION Final Report, 1972 - 1975
Robert F. Sawyer Jan. 1976 7 p refs
(Grant AF-AFOSR-2299-72; AF Proj. 9750)
(AD-A023045; UCB-ME-76-4; AFOSR-76-0167TR) Avail: NTIS CSCL 21/2

Research conducted under Air Force Office of Scientific Research Grant AFOSR-72-2299 during the period 1972-1975 is summarized and reviewed. The research included (1) flow reactor studies of ammonia oxidation, methylamine pyrolysis, and methylamine oxidation, (2) experimental methods for the study of combustion chemistry, and (3) applications of the research results to problems of aircraft engine pollutant formation and fuels. Author (GRA)

N76-32279# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
ACTIVE MANGANESE DIOXIDE OXIDATION IN ORGANIC CHEMISTRY, PART 2 Final Report
Alexander J. Fatiadi Mar. 1976 38 p refs Repr. from Synthesis, no. 3, Mar. 1976 p 133-167
(PB-252788/5) Avail: NTIS HC $4.00 CSCL 07C

Reactions in which active manganese dioxide and its various modifications provide a reagent of choice for a mild, selective, heterogeneous oxidation of diverse classes of organic compounds are reviewed. Applications of manganese dioxide as a dehydrogenation reagent, a coupling reagent, and as an analytical tool are also discussed. This survey includes 697 references. GRA

N76-32280# Vermont Univ., Burlington. Dept. of Chemistry.
ELECTROCHEMISTRY OF THE NITROPRUSSIDE ION IN NONAQUEOUS SOLVENTS
William L. Bowden, Peter Bonnar, David B. Brown, and William E. Geiger 31 Mar. 1976 18 p refs
(Contract N00014-75-C-0756; Grant NSF GP-4369X; NR Proj. 356-593)
(AD-A023462; TR-2) Avail: NTIS CSCL 07/4

The electrochemical reduction of the pentacyanonitrosylferrate (II) anion has been studied in nonaqueous aprotic media by polarography, cyclic voltammetry and coulometry. In contrast to results from aqueous solution, the initial one electron reduction proceeds with a rapid loss of cyanide to give the blue five-coordinate tetracyanonitrosylferrate(I) anion. The tetracyanonitrosylferrate(I) anion undergoes a further quasireversible reduction and an oxidation which is reversible at fast sweep rates. GRA

N76-32281# Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
STUDY OF THE INTERACTION AND CATALYTIC DECOMPOSITION OF FORMIC ACID ON SINGLE CRYSTAL NICKEL SURFACES USING AUGER ELECTRON SPECTROSCOPY AND FLESH DESORPTION Final Report
A. W. Aldag, Jr. 12 Mar. 1976 41 p refs
(Grant DA-ARO(D)-31-124-72-G14)
(AD-A022609; ARO-9788.1-C) Avail: NTIS CSCL 07/4

The interaction and decomposition of HCOOH with Ni(100) as well as the interaction of H2, CO and CO2 with Ni(110) has been studied. The rate of decompositon of HCOOH has been related to the interaction of the decompositon products. Sticking coefficients, binding energies and reaction orders have been measured. Auger Electron Spectroscopy has been used to identify the composition of the surface and the decomposition and desorption kinetics have been analyzed using the technique of flash desorption. The present results are compared with earlier studies on the HCOOH decomposition kinetics for Ni(110), and it is shown that the decomposition of HCOOH on clean nickel surfaces gives a rather striking example of the 'geometric effect' in catalysis. Author (GRA)

N76-32282# Utah Univ., Salt Lake City. Dept. of Chemistry.
DEPOLARIZED RAYLEIGH SCATTERING AND BACKBONE MOTION OF POLYPROPYLENE GLYCOL
Dane R. Jones and C. H. Wang 16 Mar. 1976 29 p refs
(Contract N00014-75-C-098; NR Proj. 051-562)
(AD-A022626; TR-11) Avail: NTIS CSCL 07/4

The depolarized Rayleigh scattering spectra of polypropylene glycol in optically isotropic cyclohexane were studied as a function of polymer molecular weight, concentration and temperature. The relaxation times were obtained by curve fitting the observed spectra to Lorentzian functions convoluted with the instrumental spectra. By studying the dependence of relaxation times on viscosity, temperature and concentration and also comparing the results with theoretical predictions of molecular and side-group reorientations, we have associated the depolarized Rayleigh scattering spectra of polypropylene glycol with the segmental motion of polymer backbone. The relaxation times for dilute solutions were found to be larger than those for concentrated solutions. The relaxation times were also found to be independent of the molecular weights of the polymer. The depolarized Rayleigh scattering results were also compared with other types of relaxation studies. GRA

N76-32283# California Univ., Irvine. Dept. of Chemistry.
DEUTERIUM ISOTOPE EFFECT ON SINGLE VIBRONIC LEVEL PHOTOCHEMISTRY OF FORMALDEHYDE ELECTRONIC TRANSITIONS: FLUORESCENCE QUANTUM YIELDS, RADIATIVE AND NON RADIATIVE TRANSITIONS Final Report, 1 Apr. 1975 - 31 Mar. 1976

Richard G. Miller and Edward K. C. Lee 12 Apr. 1976 12 p refs
(Contract N00014-75-C-0813; NR Proj. 014-506)
(AD-A023074; B-3) Avail: NTIS CSCL 20/10

Fluorescence quantum yields for various single vibronic levels and fluorescence decay times for the 4 superscript 1 level have been measured for H2CO, HDCO, and D2CO. Implications of the observed rates of radiative and nonradiative transitions to vibronic coupling mechanisms and photochemistry are discussed. Author (GRA)

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N76-32284 Utah Univ., Salt Lake City.
POSITION LIFETIME STUDIES OF HYDROGEN EMBRITTLEMENT Ph.D. Thesis
Franklin Alex 1976 131 p
Avail: Univ. Microfilms Order No. 76-20743

Positron annihilation lifetime measurements were conducted on 4340 steel specimens heat treated to four different hardnesses and strained various amounts. Lifetime measurements were also conducted on unstrained specimens of four hardnesses before and after charging with hydrogen, using both a cadmium plating solution and 1 N H2SO4 with a catalytic poison followed by cadmium plating. Microhardness and superficial hardness tests were conducted on annealed specimens after various degrees of strain. In addition, thin foils were prepared of selected specimens, which were then studied using T.E.M. Specimens of 4340 steel were also heat treated to four different hardnesses and strained various amounts; lifetime measurements were made after charging for a number of ten-minute intervals. Dissert. Abstr.

N76-32285 Rochester Univ., N.Y.
BRILLOUIN SCATTERING FROM METALS Ph.D. Thesis
Jan Gerard Dil 1976 185 p
Avail: Univ. Microfilms Order No. 76-14753

The problem of inelastic scattering of light from an absorbing medium is considered both theoretically and experimentally. As a scattering mechanism, the isobaric and adiabatic fluctuations in the density are assumed, the former one being included for the first time. The starting point of the theoretical formulation is an expression for the inelastically scattered electric far field derived from the electromagnetic boundary condition problem of a localized source in the neighborhood of a plane interface separating the scatterer from the air. The resulting energy spectrum of this field is expressed in terms of the energy spectrum of the density fluctuations. With the Brillouin spectrometer, initial scattering measurements are performed on silicon and germanium with similar findings as previously reported. The first successful Brillouin scattering measurements on liquid mercury and liquid gallium are reported. Dissert. Abstr.

N76-32286 Boston Univ., Mass.
SPIN POLARIZATION OF ELECTRON TUNNELING CURRENTS IN NICKEL ALLOYS Ph.D. Thesis
Demetris E. Paraskevopoulos 1976 96 p
Avail: Univ. Microfilms Order No. 76-21302

The electron spin polarization (ESP) of a wide range of FeNi alloys, as well as dilute alloys of Cr, Mn or Ti in Ni, was measured by the spin-polarized tunneling technique, using thin film of Al-Al2O3 ferromagnetic alloy tunnel junctions. The measurements were made at a temperature of 0.4 K and an applied magnetic field of 3.5-4.0 teslas. A phenomenological correlation between electron spin polarization and atomic magnetic moment, previously observed for the pure ferromagnetic elements (Fe, Co, Ni), is shown to be valid for all the alloys measured. A proposed explanation of the ESP based on the two-current model of conduction in Ni and preferential scattering of one spin direction depending on the type of transition metal impurity, is shown to be invalid. The results indicate that the current theories of itinerant ferromagnetism are not adequate to explain the behavior of metallic ferromagnets as it relates to the electron spin polarization of tunneling currents. Dissert. Abstr.

N76-32287 Kentucky Univ., Lexington.
DEFORMATION KINETICS IN COMMERCIAL Ti-50A AT LOW TEMPERATURE Ph.D. Thesis
Chih-An Yin 1975 163 p
Avail: Univ. Microfilms Order No. 76-20170

The mechanism responsible for the strength of commercial Ti-50A at low temperatures is ascertained, giving special attention to the method for determining the long range internal stress and the possible role of twinning, texture, and slip structure on the deformation dynamics. The textures of swaged and recrystallized wires of titanium of three interstitial purity levels were investigated. The texture of the cold worked state is a strong fiber texture. The volume fraction of twins determined by optical microscope and TEM method indicated that the twinning shear contribution to the total deformation is about 8 to 12%. At low strain rate and fixed impurities, the effect of temperature and grain size on twinning is significant. The methods for measuring the athermal component of flow stress and its values for Ti-50A material were concerned. Dissert. Abstr.

N76-32288 California State Univ., Los Angeles.
A STUDY OF HYDROGEN PERMEATION IN METALS
Dennis Lionel Dull 1976 158 p
Avail: Univ. Microfilms Order No. 76-20196

Hydrogen permeation in metals is an important consideration in elucidating structural failure by hydrogen embrittlement. Several metals, which include Ferrovac E iron, mild steel, and 4340 steel, are subjected to various thermal and mechanical processes. These processes include cold rolling and annealing, and in the case of 4340 steel, quenching and tempering. Organic compounds which may adsorb on the iron surface, are used in an attempt to block hydrogen absorption by iron. Thiourea type compounds: thiourea, phenylthiourea, and tolylthiourea; and triazole type compounds: triazole, benzotriazole, and tolyltriazole are selected. An electrochemical permeation cell is used to monitor the transient and steady state hydrogen permeation rates through the metal membrane specimens. Dissert. Abstr.

N76-32289 Duke Univ., Durham, N.C.
THE CRYSTAL STRUCTURE OF A METAL RICH INTERMETALLIC COMPOUND IN NICKEL-MAGNESIUM-BORON Ph.D. Thesis
Chandrakant Prabhudas Doshi 1976 128 p
Avail: Univ. Microfilms Order No. 76-19356

The crystal structure of a metal rich intermetallic compound in Nickel Magnesium Boron has been investigated. The compound Ni3MgB2 was prepared by crystallization from the melt using two master alloys and free nickel, free magnesium, and free boron as needed. Laue and rotating crystal methods were used to determine the symmetry and initial lattice parameters. Powder diffraction method was used to determine final lattice parameters, The crystal structure was determined by single crystal X ray diffraction analysis (diffractometer method) using crystal-monochromatized radiation. The structure was refined by the least squares method using positional parameters, and isotropic temperature factors. Difference Fourier synthesis was also used for refinement. Dissert. Abstr.

N76-32290 California Univ., San Diego.
THEORETICAL METHODS FOR THE ELECTRONIC STRUCTURE OF ALLOYS Ph.D. Thesis
Jeffrey James Olson 1976 111 p
Avail: Univ. Microfilms Order No. 76-20328

The density of states for realistic alloys is explored. In the supercell, method the disordered alloy is replaced by a crystal having an enlarged unit cell, and averages are taken over configurations of atoms within the supercell. Analysis of the moments of the density of states and numerical application to the model allow comparison with the coherent potential approximation. For this model, supercells containing an even number of atoms yield spurious structure in the density of states. The feasibility of the supercell method for muffin tin models is briefly discussed. The method for liquid iron is based on a single atom embedded in a dispersive medium, with the medium chosen to minimize scattering from the atom. Dissert. Abstr.

N76-32291 Notre Dame Univ., Ind.
STATIC AND DYNAMIC MAGNETOELASTIC COUPLING IN

FERROMAGNETIC METALS Ph.D. Thesis
Matthew ODonnell 1976 123 p
Avail: Univ. Microfilms Order No. 76-19471

A spin-phonon spectrometer has been used as the principle tool in studying the excitation of magnetoelastic waves in gadolinium and dysprosium polycrystalline films. The results of these experiments have been compared to calculations based on a coupled mode model describing dynamic magnetoelastic coupling. All experimental results are in general agreement with the analysis. Quantitative comparison has shown that the results of the dysprosium experiment are within a factor of two of the calculated signal intensities. In addition, a new magnetoelastic interaction, which is first order in both applied field and strain, has been proposed for all ferromagnetic metals. The results of spin-phonon experiments on gadolinium single crystal and microwave absorption experiments on nickel polycrystalline films imply that this new interaction must be included in the Hamiltonian of all ferromagnetic systems. Dissert. Abstr.

N76-32292*# Mar-Test, Inc., Cincinnati, Ohio.
HIGH TEMPERATURE, LOW-CYCLE FATIGUE OF COPPER-BASE ALLOYS FOR ROCKET NOZZLES. PART 2: STRAIN-RANGE PARTITIONING AND LOW-CYCLE FATIGUE RESULTS AT 538 DEG C Technical Report, Nov. 1975 - Jul. 1976
J. B. Conway, R. H. Stentz, and J. T. Berling Aug. 1976 159 p refs
(Contract NAS3-19720)
(NASA-CR-135073; MTI-R004-3-2-Pt-2) Avail: NTIS HC $6.75 CSCL 11F

Low-cycle fatigue tests of 1/2 Hard AMZIRC Copper and NARloy Z were performed in argon at 538 C to determine partitioned strain range versus life relationships. Strain-controlled low-cycle fatigue tests of a Zr-Cr-Mg copper-base alloy were also performed. Strain ranges, lower than those employed in previous tests, were imposed in order to extend the fatigue life curve out to approximately 400,000 cycles. An experimental copper alloy and an experimental silver alloy were also studied. Tensile tests were performed in air at room temperature and in argon at 538 C. Strain-controlled low-cycle fatigue tests were performed at 538 C in argon to define the fatigue life over the regime from 300 to 3,000 cycles. For the silver alloy, three additional heat treatments were introduced, and a limited evaluation of the short-term tensile and low-cycle fatigue behavior at 538 C was performed. Author

N76-32293*# Kanner (Leo) Associates, Redwood City, Calif.
INVESTIGATION OF THE ALLOYS OF THE TERNARY SYSTEMS W-HfC-C AND W-Zr-C AT SUBSOLIDUS TEMPERATURES
V. N. Eremenko, T. Ya. Velikanova, L. V. Artyukh, G. M. Akselrod, and A. S. Vishnevskiy Washington NASA Sep. 1976 12 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR, Ser. A. (Kiev), no. 1, 1976 p 80-85
(Contract NASw-2790)
(NASA-TT-F-17220) Avail: NTIS HC $3.50 CSCL 11F

Complete state diagrams were developed for the systems W-HfC-C and W-ZrC-C at subsolidus temperatures, based on data from X-ray phase and metallographic studies. Physico-chemical data are presented for the cubic tungsten and hafnium carbides. Eutectic compositions and microstructure in both systems are considered. Heated alloys were obtained in an arc furnace with argon. Solid-solution series in both systems are also discussed. Author

N76-32294# Addis Translations International, Woodside, Calif.
QUANTITATIVE EVALUATION OF ULTRASONIC BACK-SCATTERING MEASUREMENTS IN METALS
I. Koppelmann and B. Fay Jul. 1974 17 p refs Transl. into ENGLISH from Acustica (Germany), v. 29, 1973 p 297-302 Sponsored by ERDA
(UCRL-Trans-10758) Avail: NTIS HC $3.50

Measurements of ultrasonic backscatter have the advantage that sound attenuation measurements can be carried out on a side of a polycrystalline test specimen which has no plane-parallel surfaces. A formula was obtained for quantitative evaluation of the backscatter measurements and the accuracy of the formula is illustrated by means of some sample measurements. The accuracy obtained in the measurement shows that this method of measurement is comparable with the classical multiple echo method. Author (ERA)

N76-32295# California Univ., Berkeley. Lawrence Berkeley Lab.
STUDY OF ATOMIC SCATTERING FACTORS FROM THE CRITICAL VOLTAGE OF ORDERED ALLOYS, APPLICATION TO Cu3Au
A. Rocher (Laboratorie d'Optique Electronique du CNRS, Toulouse, France), R. Sinclair, and R. Thomas Sep. 1975 4 p refs Presented at 4th High Voltage Electron Microscopy Conf., Toulouse, France, 1 Sep. 1975 Sponsored in part by NATO and NSF
(Contract W-7405-eng-48)
(LBL-4563; Conf-750982-2) Avail: NTIS HC $3.50

The critical voltage (V/sub c/) effect is used to determine experimental values of the atomic scattering factor (ASF). To yield complementary information about ASF and Debye temperatures from data on an ordered alloy, Cu3Au. Reflections of the LI2 structure of Cu3Au are 100 and 110 whereas the first reflection of the disordered fcc lattice is 111. The superlattice interaction potentials V sub 100 and V sub 110 also perturb dynamical effects such as critical voltage, and it is then possible to determine their values as a function of V/sub c/. Author (ERA)

N76-32296# Salford Univ. (England). Dept. of Electrical Engineering.
THE INFLUENCE OF ION IMPLANTATION ON THE SURFACE PROPERTIES OF METALS AND ALLOYS Final Report, 1 Sep. 1971 - 31 Aug. 1975
W. A. Grant and G. Carter Oct. 1975 64 p refs
(Grant AF-AFOSR-2115-71; AF Proj. 9761)
(AD-A023249; AFOSR-76-0191TR) Avail: NTIS CSCL 13/8

Initially efforts were directed towards ion implantation of semiconductors, in particular GaP and GaAs. The main analysis technique employed was high energy Rutherford scattering combined with channelling. Measurements were made of the damage resulting from implantation of Te in GaP, together with the annealing of the damage and the lattice location of the Te. Parallel work on implantation of GaAs has also continued with particular reference to the effect of the dose rate employed during implantation. It has been found that the amount of damage resulting from a given implantation dose in GaAs can be altered by changing the dose rate. This effect may possibly be applicable to other materials and should lead to a better understanding of collision cascades in solids. GRA

N76-32297# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
RECOVERY OF ZINC FROM ZINC CHLORIDE BY FUSED-SALT ELECTROLYSIS
F. P. Haver, D. E. Shanks, D. L. Bixby, and M. M. Wong Apr. 1976 22 p refs
(PB-252517/8; BM-RI-8133) Avail: NTIS HC $3.50 CSCL 11F

A laboratory scale investigation that was made to develop a procedure for electrowinning zinc metal from ZnCl2 was described. Zinc chloride by itself is not a suitable electrolyte as it fumes badly above its melting point and is a poor conductor of electricity. Other salts must therefore be added to prevent fuming and improve conductivity. Optimum results were obtained with a KCl/LiCl/ZnCl2 bath at 500 C, using a current density of 5 amp/sq in and an electrode spacing of 0.5 in. Author (GRA)

N76-32298# Florida Univ., Gainesville. Dept. of Chemistry.
STRUCTURE AND PROPERTIES OF HIGH TEMPERATURE MATERIALS Final Report, 1 Nov. 1971 - 31 Oct. 1975
William Weltner, Jr. Dec. 1975 19 p refs
(Grant AF-AFOSR-2208-72; AF Proj. 9536)
(AD-A023131; AFOSR-76-0161TR) Avail: NTIS CSCL 21/2

The objectives of this research are (1) the characterization of the vaporization, gaseous combustion and reaction products over high temperature materials such as (a) the refractory metals and their oxides, (b) graphite and carbides, and (c) flame and propellant constituents (such as boron). (2) the determination,

via optical and ESR (electron spin resonance) spectroscopy, of the vibrational and electronic properties of these and related high-temperature molecules and the understanding and correlation of that information with theory whenever possible. GRA

N76-32299# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
INVESTIGATION OF A CELL DESIGN FOR ELECTROWINNING ZIRCONIUM METAL FROM ZIRCONIUM TETRACHLORIDE Final Report
G. M. Martinez, D. E. Shanks, J. R. Woodyard, and M. M. Wong Mar. 1976 18 p refs
(PB-252503/8; BM-RI-8125; RENO-76/2) Avail: NTIS HC $3.50 CSCL 11F

A cell concept adaptable to the large scale electrowinning of zirconium metal from zirconium tetrachloride was investigated. Tests were made in twin cells, each 12 in diam. by 33 in long. Electrowinning was performed in one chamber from which the electrolyte was transferred after electrolysis to the other chamber where it was renewed by the introduction of $ZrCl_4$ by direct sublimation. The formation of a salt plug in the connecting pipe provided a seal between the chambers. Optimum electrolyte composition, with respect to quality of the metal product and current carrying capability was determined to be a 16.7 wt pct NaF 83.3 wt pct NaCl mixture plus $ZrCl_4$ equal to about 3 wt pct zirconium. Author (GRA)

N76-32300# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
EFFECTS OF REFRACTORY METALS ON OXIDATION AND CORROSION RESISTANCE OF MAGNESIUM
M. M. Tilman, R. L. Crosby, and L. A. Neumeier 5 May 1976 16 p refs
(PB-252578/0; BM-OFR-61-76) Avail: NTIS HC $3.50 CSCL 11F

Research was conducted to determine if alloying magnesium with sparingly-soluable V, Cb, Ta, Cr, Mo, and W would inhibit burning of molten magnesium, and corrosion resistance of solid magnesium. When molten magnesium was heated for 1 hr (argon) in contact with the metals, solubilities ranged from less than 0.0010 wt-pct for Mo, Ta, Cb, or W, up to 0.0028 pct for V, and 0.0129 pct for Cr. Heating under pressure at 1,000 C resulted in 0.0544 pct soluble Cr; at 1,400 C, 0.0017 pct Cb was soluble. The Mg-Cr and Mg-W alloys exhibited slightly improved burning resistance. All alloys had diminished corrosion resistance in 3-pct NaCl solution. GRA

N76-32301# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
COMMENTS ON POSSIBLE B-SITE DISORDER IN A15 (BETA-W TYPE) COMPOUNDS Final Report
R. M. Waterstrat 22 Sep 1975 3 p refs Repr. from Solid State Commun. (England), v. 18, 1976 p 531-532
(Grant DE-02455)
(PB-252733/1) Avail: NTIS HC $3.50 CSCL 11F

In a recent paper evidence for preferential B-site disorder in A15 compounds was presented. It is shown, however, that the data in this paper lead to serious disagreements between predicted and observed phase compositions. Thus, the methods used are of doubtful validity and it is suggested that a more accurate knowledge of the phase compositions is needed. GRA

N76-32302# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
SPINODAL DECOMPOSITION IN NICKEL BASED NICKEL-TITANIUM ALLOYS Final Report
D. E. Laughlin 16 Dec. 1974 7 p refs Repr. from Acta Met. (England), v. 24, 1976 p 53-58
(PB-252726/5) Avail: NTIS HC $3.50 CSCL 11F

The early stages of the decomposition process in Ni based Ni-Ti alloys were studied by means of transmission electron microscopy. It was found that the supersaturated solid solution of Ti in Ni decomposes by the spinodal mechanism into periodic and aligned regions which are Ti rich and Ti lean. After a critical amount of Ti enters the Ti rich regions, they order continuously to the $L1_2$ (Cu_3Au) structure. The two processes then continue together until the fully ordered metastable gamma prime particles are formed. GRA

N76-32303# National Bureau of Standards, Boulder, Colo. Inst. for Materials Research.
THERMOMIGRATION OF INTERSTITIAL-SOLUTE-VACANCY PAIRS IN A DILUTE fcc ALLOY Final Report
R. A. McKee 18 Aug. 1975 7 p refs Repr. from Phys. Review B., v. 13, no. 2, 15 Jan. 1976 p 635-640
(PB-252722/4) Avail: NTIS HC $3.50 CSCL 11F

The influence of a temperature gradient on the motion of an interstitial-solute-vacancy pair in a fcc alloy was analyzed using the 'pair association' kinetic theory developed by Lidiard. In the past, an interstitial-solute-vacancy pair mechanism was used to describe the diffusion of various solutes in the group-IV elements, and this development for the kinetics of the thermomigration of such solute-vacancy pairs can be used for further evaluation of this proposed mechanism for diffusion in these alloys. GRA

N76-32304# Army Materials and Mechanics Research Center, Watertown, Mass.
AN EVALUATION OF SOME HIGH STRENGTH TITANIUM ALLOYS PROCESSED IN HEAVY SECTIONS Final Report
Richard Chait and Thomas S. SeSisto Sep. 1975 25 p refs
(AD-A022494; AMMRC-PTR-75-3; DRSAV-76-6) Avail: NTIS CSCL 11/6

Utilization of advanced titanium alloys in heavy sections depends to a large extent on the ability to fabricate these sections. This study is concerned with the high strength alpha-beta alloy Ti-6Al-6V-2Sn (Ti-662) and the metastable beta alloy Ti-8Mo-8V-2Fe-3Al (Ti-8823) and their fabrication in large sections. The extrusion technique utilized to achieve better than a 6:1 reduction ratio for a heavy section cylindrical hollow of this alloy is described. Following extrusion, the alloys were given one of two heat treatments: for the Ti-662 the solutionize and age or solutionize and overage heat treatments; for the Ti-8823 alloy the commonly suggested solutionize and age heat treatment or a direct age without the intermediate solutionized. The influence of these heat treatments is given in terms of microstructure and mechanical properties (yield strength, tensile strength, elongation, reduction of area, and fracture toughness). GRA

N76-32305# Rockwell International Science Center, Thousand Oaks, Calif. Science Center.
DEFORMATION AND SOLID SOLUTION STRENGTHENING OF TITANIUM-ALUMINUM SINGLE CRYSTALS Final Report, 20 Jan. - 31 Dec. 1975
N. E. Paton, R. G. Baggerly, and J. C. Williams Jan. 1976 24 p refs
(Contract F44620-72-C-0043; AF Proj. 9761)
(AD-A023195; SC526.7FR; AFOSR-76-0147TR) Avail: NTIS CSCL 11/6

Solid solution strengthening and deformation behavior of titanium-aluminum single crystals has been studied over the range of temperature 77-1100K and from 0 to 6.6 w/o Al. Crystal orientations have been chosen to promote prism slip, basal slip and c-a slip, and the temperature and composition dependence of the critical resolved shear stress (CRSS) for each of these slip systems has been determined. Although prism slip has the lowest CRSS of all the slip systems studied, both increasing temperature and Al concentration make the stresses for prism and basal slip converge. Deformation with a c-a slip vector is always more difficult to activate than either basal or prism slip with an a slip vector, and this resulted in fracture of crystals oriented for c-a slip by unstable shear, under certain conditions. In addition to the work on the deformation of Ti-Al crystals in compression, some studies were conducted on both creep and cyclic deformation (fatigue) of single crystals. The impact of these studies on understanding of deformation texture development and the use of textured titanium alloys in structures is briefly discussed. Author (GRA)

N76-32306# Connecticut Univ., Storrs. Dept. of Metallurgy.
THE HIGH CYCLE FATIGUE BEHAVIOR OF Ti-6Al-4V ALLOY Interim Report
R. K. Steel and A. J. McEvily Aug. 1975 28 p refs
(Contract AF-AFOSR-2703A-74; AF Proj. 9782)
(AD-A023255; UC-MET-1-1975; AFOSR-76-0149TR) Avail: NTIS CSCL 11/6

The cyclic stress-strain behavior and the S/N behavior of a

'pseudo-elastic' alloy, Ti-6Al-4V of coarsened microstructure, and of a 'plastic' material, copper, are compared. In accord with views recently put forth by Freudenthal, important differences are noted between these two types of materials. These differences include the mode of crack initiation, the intensity of the Bauschinger effect, and the level below macroscopic yield at which long-life fatigue data lie. Author (GRA)

N76-32307# Dayton Univ. Research Inst., Ohio.
ALUMINUM ALLOY 7475-T7651 STATIC AND DYNAMIC FRACTURE PROPERTIES Final Technical Report, May 1974 - Oct. 1975
Russell Cervay Dec. 1975 28 p refs
(Contract F33615-74-C-5024; AF Proj. 7381)
(AD-A023139; AFML-TR-75-220) Avail: NTIS CSCL 11/6

Alloy 7475-T7651 is a high-strength 7000-series aluminum alloy. The ultimate strength and yield strength of the material are similar to those of alloy 7475-T651. There was little difference in the tensile strength capability between the two specimen orientations that underwent test. Fracture toughness in the longitudinal direction is excellent. The test alloy is tougher than all other 7000-series alloys currently in service. The long-transverse and short-transverse fracture toughness are lower than the longitudinal oriented toughness test results. The constant amplitude cyclic crack growth rate is similar to crack growth data on the same alloy in the T7351 and T651 tempers. A salt water test solution accelerated the crack growth rate by a factor of approximately three. A 250 F (121 C), 1000 Hour, furnace thermal cycle had the following effects on the test material: reduced the tensile strength, improved the fracture toughness, had no effect on the cyclic crack growth rate, reduced fatigue life slightly, and had no effect on the stress corrosion cracking resistance. GRA

N76-32308# General Electric Co., Schenectady, N.Y.
METALLIC COMPOSITES FORMED IN SITU BY REACTIONS IN THE SOLID STATE Final Report, 18 Oct. 1974 - 18 Oct. 1975
James D. Livingston Nov. 1975 36 p refs
(Contracts N62269-75-C-0123; N00019-73-C-0173; N00019-74-C-0130)
(AD-A023007; GE-SRD-75-113; NADC-75372-30) Avail: NTIS CSCL 11/6

The major portion of this year's effort was study of the effects of alloying elements on the structure and properties of aligned Co-Si eutectoid. Of the nine alloying elements studied, only Ni could be added in appreciable quantities without disturbing the aligned eutectoid microstructure. Additions of Cr, Fe, Mn, or Cu produced cellular eutectoid microstructures. Additions of W, Ta, or Al produced eutectic, rather than eutectoid, microstructures. Most alloying additions caused a decrease in mechanical properties. Some improvement, however, was produced by alloying with W, and a Co-W-Si alloy showed a tensile strength at 900C of 78,800 psi. Other studies included electron microscope studies of quenched Co-Si microstructures, attempts to improve the room temperature ductility of Co-Si, and studies of eutectoid transformations in Ti-Cu, Mo-Fe, and Mo-Co alloys. GRA

N76-32309# Office of Naval Research, London (England).
THE ROSENHAIN CENTENARY CONFERENCE Conference Report
E. I. Salkovitz Mar. 1976 10 p Conf. held at London, 22-24 Sep. 1975
(AD-A023612; ONRL-C-6-76) Avail: NTIS CSCL 11/6

During September 22-24 1975, a conference was held in London honoring the memory of the British metallurgist, Walter Rosenhain. Some 300 metallurgists and a wide variety of engineering types flocked to the halls of the Royal Society to explore a single theme: the contribution of physical metallurgy to engineering practice. Topics discussed include steels for bridges, pipelines and offshore structures and metals for aircraft and gas turbines. GRA

N76-32310# Naval Ship Research and Development Center, Bethesda, Md.
SEAWATER CORROSION OF FASTENERS IN VARIOUS STRUCTURAL MATERIALS Research and Development Report
Harvey P. Hack Apr. 1976 37 p refs
(AD-A022885; DTNSRDC-76-0034) Avail: NTIS CSCL 11/6

Constant-immersion seawater exposures were conducted on panels with 1/4-inch bolts inserted with and without bolt sealant. Five panel materials were tested: fiber glass, 5456-H117 aluminum, HY-130 steel, titanium-6Al-4V, and 17-4pH stainless steel. The seven bolt materials were: 2024 aluminum, anodized ASTM grade 5 steel, 304 and 316 stainless steels, A286 stainless steel, MP35N multiphase, and titanium-6Al-4V. The sealant material was Coast Pro-Seal 800/B-2. Results of the study are presented. GRA

N76-32311# Terra Tek, Inc., Salt Lake City, Utah.
PHYSICAL AND MECHANICAL CHARACTERIZATION OF A POROUS TUNGSTEN Final Report, Oct. 1974 - Oct. 1975
F. H. Shipman, A. S. Abou-Sayed, and A. H. Jones Jan. 1976 56 p refs
(Contract DAAG46-75-C-0036; DA Proj. 1W1-62113-A-661)
(AD-A022664; TR-75-59; AMMRC-CTR-76-2) Avail: NTIS CSCL 11/6

The physical and mechanical characteristics of an 80 percent dense porous tungsten have been statically determined. This tungsten exhibited a sharp yield at a hydrostatic pressure of 0.93 GPa followed by work-hardening crushup. The yield surface is uniquely defined, independent of loading path. The effect of crushup on the permeability of the porous tungsten was also measured and a model is proposed to describe this behavior. Author (GRA)

N76-32312# Terra Tek, Inc., Salt Lake City, Utah.
MECHANICAL PROPERTIES OF 2014-T651 ALUMINUM TO 800 F Final Report, Oct. 1974 - Oct. 1975
R. J. Reid, A. H. Jones, and A. S. Abou-Sayed Jan. 1976 65 p refs
(Contract DAAG46-75-C-0036; DA Proj. 1W1-62113-A-661)
(AD-A022663; TR-75-53; AMMRC-CTR-76-1) Avail: NTIS CSCL 11/6

The mechanical behavior of 2014-T651 aluminum alloy has been characterized at temperatures up to 800 F. Uniaxial tension tests at 800 F have been performed at strain rates from .0001 to 10 in/in/sec and show the material to be extremely strain rate sensitive. Additional uniaxial tension tests were performed in order to determine the yield stress as a function of temperature thru 900 F at a strain rate of .0001 in/in/sec. Using a combination of axial tension/compression and torsion (applied at various stress ratios), the yield surface under conditions of multiaxial stress was determined. The results agree with the von Misses yield condition. The fracture toughness, K(IC) as a function of temperature was also measured for this alloy. Author (GRA)

N76-32313# Syracuse Univ., N.Y. Dept. of Chemical Engineering and Materials Science.
DESIGN AGAINST FATIGUE FAILURE Final Report, Mar. 1972 - Sep. 1975
V. Weiss and J. Mautz Dec. 1975 44 p refs
(Grant DA-ARO(D)-31-124-72-G136)
(AD-A022565; ARO-9699.6-E) Avail: NTIS CSCL 11/6

Fatigue crack growth data in the low and intermediate stress range obtained from tests on 2014-T6 aluminum, Ti-6Al-4V and 250 grade maraging steel, and similar data on 7075-T6 and 2024-T3 aluminum available from other investigators were analyzed. This analysis led to the formation of a new model for estimating the threshold stress intensity factor range, which involves the concept of reaching the theoretical strength at the tip of the crack when the critically stressed volume becomes so small that it can no longer contain a defect. Fatigue crack propagation experiments were also conducted in the range of 10 to the minus 7 power and 10 to the minus 9 power in./cycle (2.5 x 10 to the minus 9 power to 2.5 x 10 to the minus 11 power m/cycle) at room temperature and 375 Hz. 7050-T73651 aluminum and D6ac steel (HRC 50) were tested in room air and dry and wet argon, whereas 2014-T6 aluminum and annealed D6ac steel were tested in room air only. GRA

N76-32314# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
BIAXIAL CYCLIC HARDENING OF ANNEALED COPPER

CYLINDERS EVALUATED BY DEFORMATION PLASTICITY THEORIES Final Report, 1 Nov. 1973 - 31 Oct. 1974
H. S. Lamba and O. M. Sidebottom 1976 66 p refs
(Grant DAHC04-74-G-0050)
(AD-A022615; T/AM-406; UILU-ENG-26-6001; ARO-12148.2-RTL) Avail: NTIS CSCL 20/11

Hollow and solid circular cylinders of annealed OFHC copper were subjected to cyclic proportional strain histories. The stress-strain histories for different strain paths were correlated on the basis of Tresca and Mises effective stresses and strains, and the correlations using Tresca definitions were shown to be more representative than those of Mises. However, a deformation plasticity theory corresponding to the Tresca yield condition and Tresca effective stresses and strains did not lead to accurate predictions of the stress histories. The predictive capability of a simplified plasticity theory, which assumed that proportional straining leads to proportional stressing, was evaluated. Although this simplifying assumption was not in qualitative agreement with experimental results, its accurate characterization of the load-torque histories of solid cylinders suggests that the greater computational effort required by the constitutive equations of incremental plasticity might not be justifiable for some cyclic proportional straining situations. Author (GRA)

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N76-32315* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ULTRAVIOLET AND THERMALLY STABLE POLYMER COMPOSITIONS Patent
Ronald F. Reinisch, Hermilo R. Gloria, Ronald E. Goldsberry, and Michael J. Adamson, inventors (to NASA) Issued 22 Jun. 1976 8 p Filed 8 Nov. 1973 Supersedes N74-11926 (12 - 03, p 0258) Division of US Patent Appl. SN-321179 filed 5 Jan. 1973, US Patent-3,803,090
(NASA-Case-ARC-10592-2; US-Patent-3,965,096; US-Patent-Appl-SN-414043; US-Patent-Class-260-240G; US-Patent-Class-260-566B; US-Patent-Appl-SN-321179; US-Patent-3,803,090) Avail: US Patent Office CSCL 11G

A new class of polymers is provided, namely, poly (diarylsiloxy) arylazines. These novel polymers have a basic chemical composition which has the property of stabilizing the optical and physical properties of the polymer against the degradative effect of ultraviolet light and high temperatures. This stabilization occurs at wavelengths including those shorter than found on the surface of the earth and in the absence or presence of oxygen, making the polymers useful for high performance coating applications in extraterrestrial space as well as similar applications in terrestrial service. The invention also provides novel aromatic azines which are useful in the preparation of polymers such as those described. Official Gazette of the U.S. Patent Office

N76-32316 Utah Univ., Salt Lake City.
STRESS-STRAIN BEHAVIOR OF ORIENTED CRYSTALLINE POLYMERS: A MOLECULAR APPROACH BY DYNAMIC INFRARED TECHNIQUES Ph.D. Thesis
Krishna Kumar Rao Mocherla 1976 368 p
Avail: Univ. Microfilms Order No. 76-19952

The internal stress distributions on chain segments of highly uniaxially oriented poly(ethylene terephthalate) films resulting from external stresses were determined by the dynamic infrared technique. Stress induced changes in a skeletal infrared absorption band were deconvoluted by a numerical technique to yield molecular stress distributions. Samples of a specific PET film were examined by the above method at different stress levels so as to arrive at a comprehensive picture of the molecular mechanisms underlying the polymer film's macroscopic stress strain behavior. It was shown that stress on a polymer deforms the crystallites--an elongation along the axis of stress application and a contraction in a direction perpendicular to the above. Even though the external stress increases lateral lattice perfection, there is no significant change in paracrystalline order of the sample until perhaps close to its fracture. Dissert. Abstr.

N76-32317 Catholic Univ. of America, Washington, D.C.
STRUCTURAL RELAXATION IN GLASS FORMING LIQUIDS: APPLICATION TO DYNAMIC VISCOELASTICITY AT HIGH PRESSURES Ph.D. Thesis
Mary Ann DeBolt 1976 243 p
Avail: Univ. Microfilms Order No. 76-21490

A numerical model for structural relaxation, capable of predicting the time evolution of any property of a glass forming liquid in response to arbitrary changes in temperature and/or pressure was presented. Non-linear, non-exponential relaxation of any property subject to arbitrary temperature pressure time programs was analyzed. The model was tested by application to experimental data obtained for thermal histories of varying complexities, including single and multiple step changes in temperature, and continuous temperature variation during heating at a constant rate. The properties measured included refractive index, heat capacity, and strain rate (from which was derived an effective viscosity). Dissert. Abstr.

N76-32318 California Inst. of Tech., Pasadena.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE VISCOELASTIC BEHAVIOR OF SOFT POLYMERS Ph.D. Thesis
Wenji Victor Chang 1976 203 p
Avail: Univ. Microfilms Order No. 76-19572

A first order approximation of the theory of the so-called simple materials, describing the viscoelastic behavior of soft polymers in large deformations with twelve time-dependent material functions and three material constants, all functions of the three invariants of the deformation tensor was presented. Restricting consideration to deformations in which time shift invariance is preserved, a series of models was developed which describe the time dependence of the stress through the Boltzmann superposition integral, incorporating into it a suitable nonlinear measure of strain. The theory was developed in its most general three-dimensional form. Its predictions for homogeneous deformations were tested in a series of experiments on an uncrosslinked styrene-butadiene copolymer. For the prediction of the viscoelastic behavior of soft polymers the simplest form of the theory requires only one time function, the relaxation modulus, and a strain parameter which is a characteristic material constant. Dissert. Abstr.

N76-32319 Utah Univ., Salt Lake City.
DIELECTRIC STUDIES OF SOME ORIENTED POLYMERS Ph.D. Thesis
Tarik Yemni 1976 204 p
Avail: Univ. Microfilms Order No. 76-19291

The effect of crystalline orientation on the amorphous domains were studied. Information in distinguishing between several possible relaxation mechanisms is provided. The alpha, beta, and gamma relaxations in nylon 6-10 and branched polyethylene, alpha and gamma relaxations of linear polyethylene, alpha relaxation of nylon 7-7, and gamma relaxation of polyoxymethylene were studied dielectrically. Orientation of the samples was carried out in the solid state using an extruder apparatus. Oriented samples were studied with the electric field normal and parallel to the orientation direction. Density and heat of fusion values were obtained for all of the oriented and unoriented samples. Crystalline amorphous coupling is a function of crystalline content, higher couplings being associated with higher crystallinity.
Dissert. Abstr.

N76-32320# Bendix Corp., Kansas City, Mo.
DIELECTRIC ANALYSIS OF AN EPOXY PREIMPREGNATED MATERIAL
J. M. Walker Jan. 1976 29 p ref
(Contract AT(29-1)-613)
(BDX-613-1396) Avail: NTIS HC $4.00

The introduction to the principles of dielectric analysis as it relates to the cure mechanism of a preimpregnated material is given. The relationship between dielectric behavior and polymer response is also discussed. Dissipation versus time and temperature curves are presented and their relationship to production cycles and extent of cure analysis is shown. Author (ERA)

N76-32321# Atomic Energy Research Establishment, Harwell (England).
VARIABILITY OF THE TENSILE STRENGTH OF UNIDIRECTIONAL CARBON FIBER REINFORCED PLASTICS
J. W. Hitchon, W. H. McCausland, and D. C. Phillips Nov. 1975 61 p refs
(AERE-R-8217) AvaiL: ERDA Depository Libraries HC $4.50; UK £1.50

Unidirectional CFRP specimens were made by a variety of wet and dry fabrication techniques including wet lay-up, pultrusion, wet and dry filament winding, and pressed preimpregnated sheet in order to compare the effect of fabrication route on strength. In order to eliminate the effect of fiber variability, the fiber strengths and moduli were monitored throughout the fabrication program. The composites were tested by standard tensile and flexural tested, and also by hoop-burst tests. These tests subjected different volumes of composite to stress, and the effect of component size and stress distribution was treated by Weibull statistics. Significant differences in strength resulted from different fabrication routes. In particular high modulus fibers transferred a smaller proportion of their strength into composites than did lower modulus fibers, and significant differences in composite strength were obtained with the two different resins used.
Author (ERA)

N76-32322# Atomic Energy Research Establishment, Harwell (England).
EFFECT OF A TWO STAGE CURING SCHEDULE ON THE FIBER LOADING AND TRANSPARENCY OF UNIDIRECTIONALLY WOUND GLASS FIBER/EPOXY RESIN PLATES
E. Brown Oct. 1975 10 p refs
(AERE-R-8161) Avail: ERDA Depository Libraries HC $3.50; UK £1.00

The effect of changes in a two stage curing schedule for the resin matrix on the fiber content and transparency of filament wound glass fiber reinforced epoxy resin plates was described. It was shown that, in order to minimize the appearance of resin starvation and porosity, the resin matrix must attain a particular degree of viscosity or tackiness prior to final curing in a hot press. This precure stage was also seen to affect the fiber loading, light transmission property, and transparency of the final composite. Although a wide range of time and temperature was possible for polymerization of the matrix, the curing schedule temperatures were fixed at 100 and 150 C respectively while time at 100 C was varied. Effect of pressure at the final cure stage shows that fiber loading increases up to an optimum value of 73 percent at 667 psi. Author (ERA)

N76-32323# Midwest Research Inst., Minneapolis, Minn.
CONTINUED EVALUATION OF IN SITU-FORMED CONDENSATION POLYMERS FOR REVERSE OSMOSIS MEMBRANES Final Report, 22 Oct. 1974 - 21 Nov. 1975
J. E. Cadotte, K. E. Cobian, R. H. Forester, and R. J. Petersen Apr. 1976 89 p refs
(Contract DI-14-30-3298)
(PB-253193/7; W76-08116; OWRT-S-76-40) Avail: NTIS HC $5.00 CSCL 07C

A research program was carried out on in situ formed condensation membranes for seawater desalination that involved three parts: (1) exploratory membrane development, (2) characterization studies on a previously reported membrane, NS-200, and (3) refinement of an underwater extrusion process for microporous polysulfone sheeting. Among new membrane compositions were mphenylene diamine/formaldehyde, polyacrolein-based systems, crosslinked vinyl and acrylic copolymers, poly (piperazine isophthal amide), phenolic and aromatic polyester membranes, and poly (isophthaloyl oxalamidrazone) membranes.
GRA

N76-32324# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
EVALUATION OF SYNTHETIC AUTOMOTIVE CRANKCASE LUBRICANTS FOR MILITARY APPLICATIONS Interim Report, Jun. 1974 - Dec. 1975
John A. Russell, Sidney J. Lestz, Thomas C. Bowen, and Maurice E. LePera Dec. 1975 38 p refs
(Contracts DAAK02-73-C-0221; DAAG53-76-C-0003)
(AD-A023613; AFLRL-71) Avail: NTIS CSCL 11/8

A selection of laboratory, bench and engine tests was initiated in parallel with an analytical program intended to characterize typical synthetic base stocks and additive packages. Since the Army's principal automotive crankcase lubricant specifications are MIL-L-46152 (commercial/administrative vehicles) and MIL-L-2104C (tactical and combat vehicles), a mineral-based lubricant qualified to both of these specifications was included for reference, as were two synthetic gas turbine lubricants qualified to the USAF MIL-L-7808G and the USN MIL-L-23699B specifications.
GRA

N76-32325# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
NEVER DRAIN ENGINE OIL TECHNOLOGY, PHASE 2 Interim Report, Dec. 1974 - Aug. 1975
E. C. Owens, S. J. Lestz, and R. D. Quillian, Jr. Oct. 1975 154 p refs
(Contract DAAK02-73-C-0221)
(AD-A023256; AFLRL-72) Avail: NTIS CSCL 11/8

As the second phase of a program to evaluate methods of extending the life of engine oils, an agreement was reached with Thompson-Ramo-Woolridge, Inc. (TRW) to evaluate an experimental low-blowby piston ring assembly in an L-141 engine. The rings were initially evaluated using an engine dynamometer and were then installed in an M-151 Military Utility Tactical Truck (MUTT) for an extended road evaluation. All tests were conducted using a qualified MIL-L-2104C/MIL-L-46152 grade 30 lubricant and unleaded gasoline meeting VV-G-001690A specifications. From the results of the 35,400-km (22,000-mile) road evaluation, it appears that these low-blowby piston rings, in conjunction with high-quality level MIL-L-2104C/MIL-L-46152 qualified oils, would allow no-drain operation for its 32,000-km (20,000-mile) lifetime of the M-151 vehicle when operated in a high-mileage accumulation, high-temperature model.
Author (GRA)

N76-32326# Rock Island Arsenal, Ill. General Thomas J. Rodman Lab.
A TEST METHOD FOR MEASURING THE STIFFNESS OF COATED FABRICS AT LOW TEMPERATURES Technical Report, Nov. 1971 - Jun. 1974
Richard A. Faoro Sep. 1975 22 p refs
(AD-A023114; RIA-R-TR-76-001) Avail: NTIS CSCL 11/5

A test method was developed for use in determining the stiffness of plastic and rubber-coated fabrics at low temperatures by use of a torsional wire apparatus. From the test data obtained with this method, angular twist versus temperature curves can be prepared, and the temperatures at which the relative moduli of the coated fabric are 2, 5, 10, and 100 times as large as the modulus at room temperature can be determined. The method has been accepted by the American Society for Testing and Materials and has been published as ASTM D3388-75. GRA

N76-32327# California Univ., Berkeley. Dept. of Chemical Engineering.
POLYBLENDS OF POLY(STYRENE-b-BUTADIENE-b-STYRENE) AND POLYSTYRENE. 2: ELECTRON MICROSCOPY
M. Niinomi, G. Akovali, and M. Shen Apr. 1976 33 p refs (Contract N00014-75-C-0955)
(AD-A023218; TR-6) Avail: NTIS CSCL 07/3

Electron micrographs of a series of polyblends of poly(styrene-b-butadiene-b-styrene), SBS, and polystyrene, PS, are presented. These polyblends were cast from three different solvents, i.e., tetrahydrofuran/methyl ethyl ketone (THF/MEK), benzene/heptane and carbon tetrachloride. PS of four different molecular weights were used. It is shown that when the molecular weight of PS exceeds that in the block copolymer, a third phase in the form of 'islands' is formed. Lamellar-like structures are formed in the block domains upon the addition of homopolymer. Stretching perturbs the morphology of the block domains somewhat, and produces craze marks in the PS islands. The craze marks are removed upon annealing. These results are discussed in conjunction with the observed mechanical behavior of the same polyblends reported in part I of this series. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

N76-32328# Sandia Labs., Albuquerque, N.Mex.
TRANSITION OF COMBUSTION OF CONDENSED SYSTEMS TO DETONATION: DEVELOPMENT OF BURNING IN A SINGLE PORE
A. F. Belyaev, V. K. Bobolev, A. I. Korotkhov, A. A. Sulimov, and S. V. Chuiko Jan. 1976 39 p refs Transl. into ENGLISH from the book "Perekhod goreniya kondensirovannykh sistem vo vzryv", Chpt. 5, Pt. A, Section 22 USSR, 1976 p 115-134 Sponsored by ERDA
(SAND-76-6014) Avail: NTIS HC $4.00

The ignition and combustion of the channel of a powder charge in a rocket motor were examined. Experiments conducted clarified the role of combustion in crack development. It was established that, in the initial stage, combustion makes crack growth possible, since combustion penetrates rapidly into pores forming at the end part of the crack. In the final stage, combustion may exert a stabilizing effect, which is associated with the burning up of the tip of the crack-the stress concentrator. ERA

N76-32329# Bell Aerospace Co., Buffalo, N.Y.
ANALYSIS OF LIQUID ROCKET TANKAGE FOR MODEL LR58-RM-4 LIQUID PROPELLANT THRUST UNIT FOR THE BULLPUP MISSILE Final Report, Jun. - Nov. 1975
E. J. King and John Salvaggi Edwards AFB, Calif. AFRPL Dec. 1975 63 p refs
(Contract F04611-74-C-0007)
(AD-A022573; D8721-953003; AFRPL-TR-75-73) Avail: NTIS CSCL 21/9

The objective of the program was the assessment of Bullpup missile tankage and component compatibility with IRFNA and MAF-1 propellants, for a period of 10 - 12 years. Tankage material was the 2014-T6 aluminum alloy. Evaluation of the tank and component surfaces disclosed only minor corrosion effects of a general, surface nature. The degree of material degradation which occurred is considered insignificant and would not alter the functional capability of the missile. GRA

N76-32330# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).
STEADY STATE ANALYSIS OF HYDRAZINE CATALYTIC THRUSTERS FOR DIFFERENT TYPES OF CATALYSTS Interim Report, 1 Jan. - 30 Jun. 1975
Antonio Crespo 15 Jan. 1976 34 p refs
(Grant AF-AFOSR-2253-72; AF Proj. 6813; AF Proj. 9711)
(AD-A023231; AFOSR-76-0186TR, IR-4) Avail: NTIS CSCL 07/4

A theoretical analysis has been made to determine the characteristics of the steady state behavior of a hydrazine decomposition engine. The model makes use of the simplification that consists in considering that the ammonia decomposition is only important at high temperatures. The results are valid for different types of catalysts with different stoichiometries and reaction rates for hydrazine and ammonia decomposition. Conditions at the chamber exit are obtained analytically as a function of chamber length and other characteristics, in particular expressions are given for fractional ammonia decomposition at the exit and the specific impulse obtained if the outgoing mixture would be expanded to the vacuum. Fluid and particle temperature distributions along the chamber are also calculated keeping, however, fixed a non-dimensional parameter expressing the ratio of the mass and heat transfer from the interstitial fluid to the particle. GRA

N76-32331# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
IGNITION DYNAMICS IN RELATION TO COMBUSTION DYNAMICS OF DOUBLE BASE PROPELLANTS Final Report, 1 Feb. 1971 - 31 Jul. 1975
Martin Summerfield, L. N. Caveny, T. J. Ohlemiller, and L. DeLuca Nov. 1975 21 p refs
(Grants DA-ARO(D)-31-124-71-G51; DA-ARO(D)-31-124-71-G184)
(AD-A022611; AMS-1253; ARO-9586.4-E) Avail: NTIS CSCL 21/9

The objective of the research was to elucidate the physical and chemical factors that control ignition of double base propellants. Detailed experimental and analytical investigations were conducted to understand the ignition processes that occur at and near the propellant surface, to determine the connection between the ignitability of a propellant and its other combustion characteristics, to quantify the peculiarities of radiative ignition in comparison with hot gas ignition, and to develop a means of ranking propellant ignitability. As a result of these investigations, radiative ignition processes have been explained for a wide variety of propellant and test conditions. Author (GRA)

N76-32332# Thiokol Chemical Corp., Huntsville, Ala.
CTPB BACK-UP PROPELLANT FOR SAM-D Final Report, 1 Jun. 1972 - 30 Jun. 1975
P. O. Blackwell and R. T. Davis Aug. 1975 133 p
(Contract DAAH01-72-C-0940; DA Proj. 1X2-63302-D-212)
(AD-A023233; U-75-4505A; RK-CR-76-9) Avail: NTIS CSCL 21/9

The objective of this program was to tailor a propellant using the CTPB binder system to meet SAM-D requirements, which would serve as a back-up to the present HTPB binder system propellant selected for Engineering Development. This CTPB propellant was formulated for optimum aging stability at 130F while maintaining adequate physical properties to meet -30F structural requirements. The initial SAM-D propellant was a CTPB formulation (TP-H7038) which showed unacceptable softening during aging at 130F. It contained a trimodal blend (including special coarse) of AP oxidizer, and was formulated at a P/CA ratio of 1/.83 and a curing agent I/E ratio of 5.1. The approach was modified to delete the special coarse AP (whose internal moisture was the probable source of aging degradation) from the TP-H7038 formulation. Substitution of additional unground AP for the special coarse AP, and adjustment of the aluminum particle size allowed the desired burning rate to be achieved. Initial propellant tensile properties were better than both TP-H7038 baseline and TP-H7070 propellant properties. Aging properties were significantly improved after 130F storage. GRA

N76-32333# Analytical Sciences Corp., Reading, Mass.
ENERGY MANAGEMENT TECHNIQUES FOR FUEL CONSERVATION IN MILITARY TRANSPORT AIRCRAFT Final Report, 6 Jan. 1975 - 6 Feb. 1976
Robert F. Stengel and Fred J. Marcus Wright-Patterson AFB, Ohio AFFDL Feb. 1976 222 p refs
(Contract F33615-75-C-3039; AF Proj. 1987)
(AD-A023527; TASC-TR-545-1; AFFDL-TR-75-156) Avail: NTIS CSCL 21/4

This report presents the results of an investigation of energy management techniques for fuel conservation in a large transport aircraft, the USAF C-141A. Using the methods of optimal control theory and numerical simulation, fuel-optimal flight paths are computed and compared with conventional vertical profiles for typical mission scenarios. Algorithms for on-board guidance to minimize fuel use are synthesized and evaluated, and functional requirements for system implementation are developed. Concepts for flight testing this throttle/energy management technique are presented. GRA

N76-32334# Naval Research Lab., Washington, D.C.
BIOCIDAL PROPERTIES OF ANTI-ICING ADDITIVES FOR JET AIRCRAFT FUELS Final Report
C. A. Bailey and R. A. Neihof Mar. 1976 11 p refs
(NRL Proj. G04-05)
(AD-A022839; NRL-MR-3230) Avail: NTIS CSCL 21/4

As part of an effort to find an improved anti-icing additive for jet aircraft fuel the anti-microbial activity of five glycol ether compounds was examined and compared with the currently used additive, 2-methoxyethanol. Cladosporium resinae, Gliomastix sp., Candida sp., and Pseudo-monas aeruginosa were used as assay organisms. Diethylene glycol monomethyl ether, triethylene glycol monomethyl ether, and triethylene glycol monoethyl ether

had approximately the same biocidal and biostatic properties as 2-methoxyethanol and appear to be suitable jet-fuel additives as far as the antimicrobial function is concerned. A relatively higher biocidal potency was shown by 2-propoxyethanol and 2-butoxyethanol, possibly because of their greater surface activity; however, nonbiological considerations preclude their use as fuel additives. Author (GRA)

N76-32335# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
CORRELATION STUDY OF THERMAL STABILITY TEST METHODS Final Report, Feb. - Nov. 1974
Leonard C. Angello and Royce P. Bradley Sep. 1975 179 p refs
(AF Proj. 3048)
(AD-A023403; AFAPL-TR-75-4) Avail: NTIS CSCL 21/4

A study was conducted to determine the degree of correlation between aviation turbine fuel thermal stability test methods ASTM D 1660 and ASTM D 3241. The primary parameters investigated in the study were tube deposit and filter pressure drop break-point temperatures as evaluated on the ASTM-CRC Fuel Coker and the JFTOT thermal stability test devices. Correlations are classified by fuel type (JP-4 and kerosene type), tube deposit rating method (Visual, Spun 18 and Spot 20), and order of curve fit (linear and quadratic). GRA

N76-32336# Federal Energy Administration, Washington, D.C. Strategic Petroleum Reserve Office.
EARLY STORAGE RESERVE PLAN
Apr. 1976 108 p refs
(PB-252574/9; FEA/G-76/158) Avail: NTIS HC $5.50 CSCL 21D

The Early Storage Reserve Plan (ESR) was prepared in response to Section 155 of the Energy Policy and Conservation Act (Public Law 94-163), which calls for storage of 150 million barrels of crude oil by December 1978. This ESR storage requirement will be added to the Strategic Petroleum Reserves (SPR) after the SPR plan goes into effect. ESR is to provide for fulfilling residual fuel and refined product needs in any region that is or is to become heavily dependent on imports. The feasibility of an ESR plan is demonstrated by discussing plans and work on: (1) how the ESR will be developed; (2) how it will be managed under normal and emergency conditions, and (3) what the environmental and economic effects of the ESR will probably be. GRA

N76-32337# A. P. T., Inc., San Diego, Calif.
EVALUATION OF SYSTEMS FOR CONTROL OF EMISSIONS FROM ROCKET MOTORS, PHASE 1 Interim Report, Dec. 1974 - Jun. 1975
Seymour Calvert and Samuel Stalberg Aug. 1975 54 p refs
Prepared for USAF Rocket Propulsion Lab., Edwards AFB, Calif. (Contract EPA-68-02-1328)
(PB-245590/5; EPA-600/2-75-021-a) Avail: NTIS HC $4.50 CSCL 21I

Results are given of design studies related to the control of emissions from solid rocket test firings. Results are provided of an examination of a pilot scale scrubber. If a similar scrubber is used on a large engine (e.g., 2 million N or 450,000 lb), the amount of liquid required to lower the exhaust velocity is quite high. As a remedy, the installation of scoops is proposed, to recycle the liquid. Theoretical performance characteristics for the scoops are derived, and an experiment to test their utility is proposed. GRA

N76-32351* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID PROPELLANT DYNAMICS ANALYSIS
Frank M. Bugg *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 213-223 refs (For availability see N76-32339 23-31)

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N76-32338# Coast Guard, Washington, D.C.
A MANUAL FOR THE SAFE HANDLING OF INFLAMMABLE AND COMBUSTIBLE LIQUIDS AND OTHER HAZARDOUS PRODUCTS
1 Jun. 1975 140 p refs
(USCG-174) Avail: NTIS HC $6.00

Good operating practices based on regulations, plus procedures which have proven effective over years of use, are discussed. These practices are applied to tank ships, barges, and personnel. Designs of the tank vessel and equipment are described, along with pollution control, liquefied flammable gas handling, and bulk dangerous liquids. J.A.M.

N76-32339# Shock and Vibration Information Center (Defense), Washington, D.C.
SHOCK AND VIBRATION COMPUTER PROGRAMS: REVIEWS AND SUMMARIES
Walter Pilkey, ed. and Barbara Pilkey, ed. 1975 657 p refs
(Contract N00014-69-A-0060-0012)
(SVM-10; LC-75-27337) Avail: NTIS MF $2.25; HC available from Shock and Vibration Information Center, Naval Research Laboratory, Code 8404, Washington, D. C. 20375

Computer programs for dynamic structural analysis are presented for various structures, such as beams, cable nets, pipes, roofs, etc. The applications and economics of the varied programs are emphasized. For individual titles, see N76-32340 through N76-32373.

N76-32340 California Univ., Davis. Dept. of Mechanical Engineering.
MULTIPLE ENERGY DOMAIN SYSTEMS **c39**
Dean Karnopp *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 3-7 refs (For availability see N76-32339 23-31)

Basic types of computer programs are discussed for aiding the analysis and design of multiple energy domain vibratory systems. Digital and analog programs are compared, along with single domain formulators, analyzers, and simulators. Two formulator programs are contrasted: (1) simulation program with integrated circuits emphasis (an electrical circuit program), and (2) ENPORT (program specifically designed for multiple energy domain systems). J.A.M.

N76-32341 University of South Florida, Tampa.
TRANSFER FUNCTION ANALYSIS **c39**
James C. Bowers and Gary A. Shaw *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 9-44 refs (For availability see N76-32339 23-31)

The theory of Laplace transforms and their application to the formulation of transfer functions is reviewed. Four computer programs, possessing various transfer function analysis capabilities, are examined. Program features are demonstrated by means of examples, and a method for representing certain piecewise linear systems is also described. Author

N76-32342 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DYNAMICS OF SPACECRAFT STRUCTURES **c39**
Leonard Meirovitch *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 45-61 refs (For availability see N76-32339 23-31)

Computer programs in the area of dynamics of flexible spacecraft tend to be tailored to specific spacecraft. The programs are generally very extensive and they are modular in nature, in the sense that they consist of a group of subprograms integrated into a single general program. The flexible spacecraft program simulates attitude and flexural motions of general spacecraft with long tubular appendages subjected to orbital perturbing forces including gravitational forces, solar pressure, temperature gradients, aerodynamic drag, and magnetic torques. LPARL flexible spacecraft attitude dynamics program consists of a series of multipurpose digital computer programs for simulation of the attitude dynamics and control of complex spacecraft structures representable as rotationally interconnected rigid and flexible bodies. Martin Marietta computer program is a general purpose computer program system for dynamic simulation and stability analysis of passive and actively controlled spacecraft. MBDY attitude dynamics subroutine package, spinning structural analysis program group, structural performance analysis and redesign,

and Westinghouse electrical computer program are also described. J.A.M.

N76-32343 Naval Ship Research and Development Center, Bethesda, Md.
TORSIONAL SYSTEMS **c37**
N. T. Tsai *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 63-71 refs (For availability see N76-32339 23-31)

Most special purpose programs are developed for the steady state analysis of geared systems. Although some can be extended to transient analysis, only program CADENSE-24 provides the transient analysis model with backlash capabilities. General purpose computer programs can meet the need of most users. These programs are different from each other in methodology and size. Several programs are summarized: SHAFTRAN, Bond Graph programs, CADENSE-22 and 23, TAGS, TABU, TOFA, COSMIC, and Rotating, twisted beam. J.A.M.

N76-32344 Virginia Polytechnic Inst. and State Univ., Blacksburg.
CRASH SIMULATION **c03**
M. P. Kamat *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 73-82 refs (For availability see N76-32339 23-31)

Types of energy absorbers for crash simulation are discussed; they include: (1) hydraulic or pneumatic, (2) material deformation, (3) friction, (4) extrusion, and (5) compaction and/or compression. There are essentially three ways of predicting energy absorption during impact: analytical, numerical, and hybrid. Simulators that are rather broad in scope, well documented, nonproprietary, and which could be used mainly for prediction of energy absorption are considered. J.A.M.

N76-32345 Polytechnic Inst. of Brooklyn, N.Y.
CABLE SYSTEMS **c37**
Nicholas F. Morris *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 93-101 refs (For availability see N76-32339 23-31)

Cable systems used for suspension bridges, mooring lines, and suspended roofs are discussed. Dynamic analysis is considered, along with the nonlinearity of various systems. J.A.M.

N76-32346 Bechtel International Corp., San Francisco, Calif.
OFFSHORE STRUCTURES ANALYSIS **c39**
V. Dunder and G. Belonogoff *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 103-128 refs (For availability see N76-32339 23-31)

The response of a marine structure must account for the action of ocean surface waves, current, wind, gravity loading, and other loading conditions. In complex systems, the fluid-structure-soil interaction must be simulated to obtain a realistic structural model. The response of fixed-base platforms, floating rigs, or large submerged structures, including certain marine components such as risers, pipelines, and moorings, are discussed. Author

N76-32347 Texas Univ., Austin.
FRAMES **c39**
R. R. Craig, Jr. and C. P. Johnson *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 129-150 refs (For availability see N76-32339 23-31)

The programs which are described solve a broad range of frame structural dynamics problems. The key ingredient in all frame programs is the frame element, a one dimensional element with six degrees of freedom at each end. Frame elements may be assembled to form structures ranging from continuous beams to three dimensional frame structures. Some programs permit structures of arbitrary geometry to be described. Several programs are restricted to specialized models of building frames. The types of dynamic behavior represented are: eigenvalue/eigenvector extraction, transient response, harmonic response, and seismic (shock spectrum) response. Some programs are restricted to linearly-elastic response of structures, while others permit material and/or geometric nonlinearity. All programs reviewed are based on the finite element displacement method. Author

N76-32348 Sandia Labs., Albuquerque, N.Mex.
NONLINEAR TRANSIENT RESPONSE OF SOLIDS **c39**
Walter Herrmann *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 151-172 refs (For availability see N76-32339 23-31)

Computer programs are considered which are capable of solving problems involving the transient mechanical response of solid bodies. A conspicuous feature of such response is the propagation of stress waves. Transient problems can be disconcertingly complicated, even for seemingly simple initial and boundary conditions. A localized impact or explosion may include stress waves which reverberate throughout the body, perhaps to cause failure at a location remote from the excitation. Computations with sufficient resolution to follow stress waves through several reverberations in the body can be done by intelligent use of the programs, although they are often time consuming and expensive due to the detail which may be required to ensure that the important physical phenomena are retained. Author

N76-32349 Tokyo Univ. (Japan).
TIME DEPENDENT MATERIALS **c39**
Yoshiaka Yamada *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 173-188 refs (For availability see N76-32339 23-31)

The mathematical structure of the theory of viscoelasticity is initially reviewed in the discretized form for the uniaxial loading case. The constitutive equation is then extended to the multiaxial stress field. Not only the transient phenomena, but also the harmonic responses, are considered, and it is shown that the formulation which assumes that the creep potential can be included in the mechanical model theory is a special case. Several computer programs were developed specifically for performing viscoelastic structural analysis. Author

N76-32350 Virginia Univ., Charlottesville.
PREDICTION OF HIGHWAY NOISE **c45**
John K. Haviland *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 189-211 refs (For availability see N76-32339 23-31)

Methodologies, four corresponding computer programs, their varients, and other computer programs for highway noise are summarized. Differences between the four programs are relatively minor, since all lean heavily on empirical laws. Problems encountered in coming up with satisfactory methods of predicting highway noise are typical of those encountered in any systematic approach to acoustical analysis. New and powerful methods of analytical solutions were developed in such fields as fluid dynamics and solid mechanics; the acoustical equation has defied the modern computer, so that methods of predicting attenuations in the presence of obstructions and rough ground are still quite unreliable. Author

N76-32351* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID PROPELLANT DYNAMICS ANALYSIS **c28**
Frank M. Bugg *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 213-223 refs (For availability see N76-32339 23-31)

The effects of liquid propellant on liftoff and maneuvering of spacecraft are discussed, including the propellant behavior regimes. The equations of motion are linearized and solved for small amplitude oscillations of an ideal, incompressible liquid in a tank described by the revolution of an arbitrary curve about an axis of symmetry. Computer programs for high and low bond numbers and lomen and hydroelastic sloshes are described. LOBOND is a combination of two programs, computing the equilibrium free surface shape and the lateral vibration mode shapes and frequencies for liquid in a container of arbitrary axisymmetric shape with surface tension forces. LAMPS is a program to simulate the large amplitude slosh of propellant in a low gravity environment. LHMAC2 is a modification of an existing marker and cell program. It was developed to describe large amplitude motion (either transient or periodic) of liquid in a tank. J.A.M.

N76-32352 Wisconsin Univ., Madison.
OPTIMUM DESIGN OF DYNAMIC MECHANICAL SYSTEMS **c37**

A. Seireg *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 225-234 refs (For availability see N76-32339 23-31)

Rational design procedures require problem formulation in mathematical terms and development of logic and decision steps necessary to facilitate the search for optimum solutions. Various programs are described for optimization of vibratory systems, such as CONMIN, ADAMS, IOWA CADET, SOAR, and WIDOWAC. J.A.M.

N76-32353 Lockheed Missiles and Space Co., Palo Alto, Calif.
MECHANICAL AND THERMAL SHOCK ANALYSIS c39
Philip Underwood *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 235-246 refs (For availability see N76-32339 23-31)

Lumped parameter structural dynamic computer programs are used to view the world as composed of masses connected by weightless springs and dampers. The structure's mass is divided into discrete lumps, each of which is coupled to others by the springs and dampers to produce a dynamic model of the structure. Any forcing function that produces a transient response that is significant in magnitude compared with the steady state response can be called a shock loading. For structural dynamic analysis, these shock loadings are characterized by sudden changes in surface, displacement, or thermal loads. Time integrators and shock spectra are reviewed. Lumped parameter computer programs and shock spectrum computer programs are presented in tabular form. J.A.M.

N76-32354 Lummus Co. Canada Ltd., Toronto.
RANDOM VIBRATION OF STRUCTURES c39
C. Sundarajan *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 247-252 refs (For availability see N76-32339 23-31)

Fifteen commercially or publicly available computer programs are briefly summarized for random vibration analysis of structures. The relative merits of the programs from the user's point of view and a general guideline on the choice of programs are discussed. Author

N76-32355 Pratt and Whitney Aircraft, East Hartford, Conn.
BEAMS c39
Andrew Jay *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 253-272 refs (For availability see N76-32339 23-31)

The economics of computer programs for beams is reviewed. The most common numerical techniques used for beam analysis are analytical numerical integration, the finite element method, the transfer matrix method, and the finite difference method. Appropriate computer programs are summarized, such as SPIN, Beam Response, NUBWAM, DANAXX4, NOMOD, TIMOSH FAMSUB, DEPROSS1, and OMEGA2. Program capabilities are plotted against beam characteristics. J.A.M.

N76-32356 Westinghouse Research Labs., Pittsburgh, Pa.
PIPING SYSTEMS c39
C. Visser and A. J. Molnar *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 273-298 refs (For availability see N76-32339 23-31)

A survey is presented for computer programs which are applicable to the shock and vibration analysis of piping systems. Efforts are made to identify the methods on which the majority of computer programs for piping analysis is based, including elastic-plastic behavior and large deformations and strains. These methods are limited to finite element techniques, and the finite elements used for piping analysis are briefly described. The desirable features for efficient and economical analysis of piping systems are reviewed followed by a description of computer programs currently available for piping analysis. Author

N76-32357 Naval Postgraduate School, Monterey, Calif.
DYNAMIC BUCKLING OF STRUCTURES c39
Robert E. Ball *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 299-321 refs (For availability see N76-32339 23-31)

Computer programs are considered for the dynamic buckling of beam, plate, and shell type structures due to deterministic forces. The material presented is intended to assist the analyst in selection of the proper software and in the development of a meaningful numerical model for dynamic buckling. Several examples of dynamic buckling are described to illustrate the various aspects that must be considered such as snap buckling, asymmetric buckling, and parametric resonance. The most common methods of solution are briefly discussed and some modeling guidelines are given. Most of the public and commercially available programs for the geometrically nonlinear, dynamic analysis of thin beam, plate, and shell structures are described in detail. User evaluations are also listed. Author

N76-32358 Los Alamos Scientific Lab., N.Mex.
LIMITING PERFORMANCE OF STRUCTURAL SYSTEMS c39
Paul D. Smith and Walter D. Pilkey (Virginia Univ.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 323-328 refs (For availability see N76-32339 23-31)

Computer codes for limiting performance analysis are discussed. These include: COSI (Configuration-free Optimum Shock Isolation), PERFORM (Performance Optimizing Computer Program), and SYSLIPEC (Steady-state Limiting Performance Code). All three of these codes are pre- and postprocessors for use with the Control Data Corporation OPTIMA linear programming package. Results are presented of a limiting performance analysis of shock absorbers in freight car couplings. Operating details of the codes are listed. Author

N76-32359 Texas A&I Univ., Kingsville.
GRILLAGES c39
Thein Wah *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 329-336 refs (For availability see N76-32339 23-31)

The term grillage is usually understood to mean a network of beams rigidly connected at their intersections. In actual practice such a network usually forms the supporting framework for a plate or envelope which transmits the superimposed load to the grillage. In many structures the grillage forms the primary load carrying component, and the safety of structure is dependent on its satisfactory performance. Various computer programs developed for the dynamic analysis of grillages are discussed. Author

N76-32360 Massachusetts Inst. of Tech., Cambridge.
KINEMATIC AND DYNAMIC DESIGN OF MECHANISM c37
Roger E. Kaufmann *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 337-346 Sponsored by NSF (For availability see N76-32339 23-31)

Programs for the kinematic analysis and synthesis of mechanisms are surveyed. Coverage is extended to include programs dealing with nonkinematic properties such as static forces, joint friction, and mechanism dynamics. Author

N76-32361 City Coll. of the City Univ. of New York.
SEISMIC ANALYSES c46
Charles A. Miller and Carl J. Costantino *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 347-364 refs (For availability see N76-32339 23-31)

Computer software that is available to treat the seismic response problem when dynamic effects are included is discussed. The subject area is divided into the following areas of interest: free-field, structure/media interaction, and structural response. In each of the areas the alternative approaches which can be used in generating solutions are first discussed followed by a presentation of computer software which is available. So that each of the above areas may be put into proper perspective, an overview of the seismic design problem is given. Author

N76-32362 Michigan Univ., Ann Arbor. Highway Safety Research Inst.
SIMULATION OF HUMAN BODY RESPONSE TO CRASH LOADS c52
D. H. Robbins *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 365-380 refs (For availability see N76-32339 23-31)

Computer programs which simulate human body response to crash loads are described. These simulations are adapted to

the study of aircraft occupants, pedestrians, cyclists, and automobile occupants. These programs are compared in terms of (1) sources of documentation, information, and contacts for obtaining the programs, (2) parameters defining the crash victim, (3) the means by which forces are transmitted to the victim, and (4) the acceleration or other kinematic inputs which force a dynamic interaction between the environment and the victim. Author

N76-32363 TIME/DATA Corp., Palo Alto, Calif.
TEST DATA REDUCTION AND PROCESSING **c61**
Loren D. Enochson *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 381-404 refs (For availability see N76-32339 23-31)

A review is presented of computer software and hardware systems employed in shock and vibration test data analysis. Software packages are generally available for large-scale computers and are often written in a high level language (e.g. FORTRAN) making them generally available for a wide class of medium to large scale machines. There is also available a broad class of special purpose hardware systems essentially based on digital circuitry implementations of the fast Fourier transform. A closely related group of systems is minicomputer based, with custom software for the particular minicomputer involved. It tends to appear functionally much the same as the true hardware devices but is fundamentally distinct. All these systems are in daily use in shock and vibration data analysis. Basic time series data analysis methods are discussed including the following: amplitude domain; time domain; and frequency domain. Author

N76-32364 Naval Underwater Systems Center, New London, Conn.
FLUID STRUCTURE INTERACTION **c34**
A. J. Kalinowski *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 405-452 refs (For availability see N76-32339 23-31)

Computer programs developed to study the combined problem of fluid structure interaction are surveyed. These programs are divided into the following categories: physical phenomena, time variation, structure type, and fluid region type. J.M.S.

N76-32365 Franklin Inst. Research Labs., Philadelphia, Pa.
ROTATING MACHINERY **c37**
William Shapiro, Garnett C. Horner (Virginia Univ.), and Walter D. Pilkey (Virginia Univ.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 453-496 refs Sponsored in part by AROD (For availability see N76-32339 23-31)

A rotating machine is a system of components and the vibration characteristics of the rotor are a function of many of these components. Computer codes which effectively represent the system, including the separate components are discussed. Author

N76-32366* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT NOISE PREDICTION **c71**
Jimmy Cawthorn and Ronnie Gillian *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 497-505 refs (For availability see N76-32339 23-31) CSCL 20A

Aircraft noise prediction programs which are generally available are described. A background discussion including levels of acoustical sophistication and units of measure is also presented as an aid to understanding the requirements of an aircraft noise prediction system. Author

N76-32367 Lehigh Univ., Bethlehem, Pa.
SHELL ANALYSIS **c39**
Arturs Kalnins and Lawrence I. Weingarten (Sandia Labs., Albuquerque, N. Mex.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 507-525 refs Sponsored in part by ERDA (For availability see N76-32339 23-31)

The theoretical background of shell dynamic response and the description and characteristics of the more widely-used structural software packages for shell dynamic computation are considered. The dynamic response problem is defined in terms of the spatial distribution of the loading and the frequency representation of particular shell theories. Also, the solution procedures for transient analysis are discussed. Structural software for the dynamic response problem is dealt with. The various shell theories that have been implemented computationally and the characteristics and special features of current programs are described. Author

N76-32368 Commonwealth Associates, Inc., Jackson, Mich.
SUMMARY OF GENERAL PURPOSE PROGRAMS **c61**
Suresh K. Desai *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 529-536 refs (For availability see N76-32339 23-39)

The dynamic capabilities of general purpose shock and vibration programs are summarized. Broad requirements for general purpose programs are outlined along with characteristics common to most programs. It is indicated that no general purpose program is suitable for all situations. J.M.S.

N76-32369 Illinois Univ., Chicago.
NONLINEAR ANALYSIS DESCRIPTION AND NUMERICAL STABILITY **c64**
Ted Belytschko *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 537-562 refs (For availability see N76-32339 23-31)

Aspects of the nonlinear transient problem are discussed. These include: the kinetic, kinematic, constitutive, and mesh descriptions; and the stability of the numerical integration schemes. The aim is to present the methods that are currently used in solid and structural mechanics software, and to evaluate and compare these methods. Author

N76-32370 Stanford Research Inst., Menlo Park, Calif.
FRACTURE AND FRAGMENTATION UNDER SHOCK LOADING **c39**
Lynn Seaman *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 563-577 refs (For availability see N76-32339 23-31)

Fracture and fragmentation may occur under shock loading caused by impact, air shock, deposition of intense thermal radiation, or the detonation of explosives. Simulation of such processes requires a wave propagation computer program and criteria for the occurrence of fracture and fragmentation under shock conditions. Such damage criteria are outlined and the means for selecting an appropriate criterion are described. Several one- and two-dimensional wave propagation codes are listed. Emphasis is on the fracture models that represent one small feature of such codes. Author

N76-32371 Texas A&M Univ., College Station.
EIGENVALUE EXTRACTION **c64**
Robert A. Wilke and James A. Stricklin *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 579-601 refs (For availability see N76-32339 23-31)

The eigenvalue and eigenvector extraction routines that are available to shock and vibration analysts are described. The analyst will be most often concerned with the calculation of eigenvalues and eigenvectors in buckling and vibration problems. For the buckling problem the lowest eigenvalue is needed, whereas for vibration problems several or all of them may be required. The specific number required will depend upon the problem and the type of analysis being performed. The problem being considered and the character of the matrices in the basic relations will be factors in the particular eigenvalue solution routine that is used. Author

N76-32372 Tufts Univ., Medford, Mass.
DAMPING **c39**
Frederick C. Nelson and Rober Greif *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 603-623 refs (For availability see N76-32339 23-31)

Damping forces are reviewed followed by a comprehensive discussion of damping in multi-degree-of-freedom systems. Results are reported of a survey aimed at establishing which damping hypotheses are available in various computer programs and the relative success of these programs in solving problems of damped response of discrete, multi-degree-of-freedom models. Author

N76-32373 Pennsylvania State Univ., University Park.
INERTIA MATRICES FOR FINITE ELEMENTS **c39**
Vernon H. Neubert *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 625-649 refs (For availability see N76-32339 23-31)

The representation of the mass distribution of a structure has received considerable attention from the developers of some computer programs. The programs and the mass matrices used are discussed. Attention is given to those which are of particular interest because of schemes used. To represent elements with uniformly distributed mass, the two main choices are: a lumped mass, with a diagonal mass matrix; or a consistent mass, with a nondiagonal mass matrix. Computer programs which were developed for structural analysis are emphasized. Two programs for the calculation of inertial and damping contributions of a fluid are briefly discussed. Author

N76-32374# European Space Agency, Paris (France).
HEAT PIPES
1976 658 p refs Proc. of the CNR 2d Intern. Conf., Bologna, 31 Mar. - 2 Apr. 1976; co-sponsored by AIAA, ESA and EURATOM
(ESA-SP-112-Vol-1-Preprint) Avail: NTIS HC $16.25

Conference papers on heat pipes (gravity-assisted, low-temperature, liquid-metal, variable-conductance, and rotating) heat pipe materials, and evaporative heat transfer, as well as their terrestrial, zero-gravity, and spacecraft applications are presented. For individual titles, see N76-32375 through N76-32432.

N76-32375 Los Alamos Scientific Lab., N.Mex.
HELICAL WICK STRUCTURES FOR GRAVITY-ASSIST HEAT PIPES **c34**
J. E. Deverall and E. S. Keddy *In* ESA Heat Pipes 1976 p 3-10 refs Sponsored by Energy Res. and Develop. Admin. (For availability see N76-32374 23-31)

A program was undertaken to develop a wick structure suitable with potassium as a working fluid in heat pipes for thermal control of irradiation capsules having a high heat transfer capability in the temperature range from 870 to 920 K. The most suitable design appeared to be a multiple-helix system which provides a low flow resistance, minimum liquid inventory, good liquid distribution, a relatively large vapor passage, and a means for reducing liquid-vapor interaction. Seven different wick structures were designed and tested and heat transfer rates up to 10 kW were attained. Results indicate that high capacity heat pipes can be constructed to operate in the gravity-assist mode in a lower temperature range than is possible with sodium. The tests also revealed a new heat pipe limit not previously considered. The results of these tests show that potassium is a useful fluid for high-capacity heat pipes operating in the gravity-assist mode at lower temperatures than is possible with sodium. The helical wick structures make it possible to achieve high heat transfer rates which are desirable for irradiation capsules and can be used in many thermal-control applications where gravity-assist heat pipes are required; however more development work must be done to simplify the wick construction and investigate additional wick designs. Author (ESA)

N76-32376 Los Alamos Scientific Lab., N.Mex.
VAPOR FLOW CONSIDERATIONS IN CONVENTIONAL AND GRAVITY-ASSIST HEAT PIPES **c33**
J. E. Kemme *In* ESA Heat Pipes 1976 p 11-22 refs Sponsored by Energy Res. and Develop. Admin. (For availability see N76-32374 23-31)

Four separate effects and their associated limitations encountered in experiments with liquid-metal working fluids particularly in gravity-assist heat pipes were identified. They include the ultimate vapor, the pressure gradient, the entrainment, and the vapor pressure drop limitations. Equations are provided to show how these limitations are influenced by heat pipe geometry, wick structure, working fluid properties, and manner of operation. It is emphasized that some equations are tentative in nature and require additional experimental verification. ESA

N76-32377 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
INVESTIGATION OF PERFORMANCE OF GRAVITY ASSISTED COPPER-WATER HEAT PIPES **c33**
A. Abhat and H. Nguyenchi *In* ESA Heat Pipes 1976 p 23-36 refs (For availability see N76-32374 23-31)

An experimental investigation of the hydrodynamics and heat transfer characteristics of gravity aided copper-water heat pipes was carried out. The operating temperature, tilt angle, and liquid inventory within the heat pipe were used as parameters. The data were compared to predictions from a liquid puddle model and the latter was found inadequate for tilted wicked heat pipes. The role of nucleate boiling in causing performance limitation of the heat pipes is discussed. Author (ESA)

N76-32378 Odessa Technological Inst. of Food and Refrigerating Industries (USSR).
LOW TEMPERATURE TWO-PHASE CLOSED THERMOSYPHON INVESTIGATION **c34**
Z. R. Gorbis and G. A. Savchenkov *In* ESA Heat Pipes 1976 p 37-45 refs (For availability see N76-32374 23-31)

Technological effectiveness, low cost, high heat transfer efficiency, and high value of critical heat flux are advantages of two-phase closed thermosiphons compared to heat pipes at normal gravity conditions. Water, ethanol, Freon 113, and perfluoro dibutyl ether were used as heat carriers. The filling rate, inclination effect, and noncondensable gas rate were investigated. Boundary conditions at the heated length were realized. Previous author data and results have shown that boundary conditions affect boiling heat transfer in two-phase closed thermosiphons. Condensation (condensing) heat transfer at the cooled zone of the thermosiphon obeys Nussel's theory if the length of noncondensable gas region is taken into account. The inner surface of the thermosiphon was found in a good state after more than 2,000 hr operation. ESA

N76-32379 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
PERFORMANCE INVESTIGATION OF CRYOGENIC HEAT PIPES **c34**
W. Molt *In* ESA Heat Pipes 1976 p 49-62 refs Sponsored in part by DFVLR-BPT (For availability see N76-32374 23-31)

To obtain parametric performance data on heat pipes, seven wick structures and two working fluids were used so as to allow a comparison of the relative performance of the various heat pipes. In addition, equations for determination of properties of cryogenic fluids were obtained from bibliographies and property values computed for CH4 and CF4 as working fluids. The maximum heat transport capability of the heat pipes filled with CH4 and CF4 was measured as a function of temperature and tilt height. Experimental results were compared with predictions obtained using the simplified capillary limit theory. ESA

N76-32380* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARAMETRIC PERFORMANCE OF CIRCUMFERENTIALLY GROOVED HEAT PIPES WITH HOMOGENEOUS AND GRADED-POROSITY SLAB WICKS AT CRYOGENIC TEMPERATURES **c34**
M. Groll, R. B. Pittman, and J. E. Eninger (TRW Systems Group, Redondo Beach, Calif.) *In* ESA Heat Pipes 1976 p 63-76 refs (For availability see N76-32374 23-31)
CSCL 20D

A recently developed, potentially high-performance nonarterial wick was extensively tested. This slab wick has an axially varying porosity which can be tailored to match the local stress imposed on the wick. The purpose of the tests was to establish the usefulness of the graded-porosity slab wick at cryogenic temperatures between 110 and 260 K, with methane and ethane as working fluids. For comparison, a homogeneous (i.e., uniform porosity) slab wick was also tested. The tests included: maximum heat pipe performance as a function of fluid inventory, maximum performance as a function of operating temperature, maximum performance as a function of evaporator elevation, and influence of slab wick orientation on performance. The experimental data were compared with theoretical predictions obtained with the GRADE computer program. Author (ESA)

N76-32381 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
MODULAR AXIAL GROOVED HEAT PIPES **c34**
H. Koch, H. Kreeb, and M. Perdu *In* ESA Heat Pipes 1976

p 77-82 (For availability see N76-32374 23-31)

A modular axial grooved heat pipe system operable between 100 and 400 K was developed. Accent was placed on typical space application problems such as assembly of two heat pipes (interface problems), circular heat pipes, construction of radiators, long life behavior, and cryogenic heat pipes. Results of performance tests on this heat pipe system designed for a space radiator to be used in an output multiplexer are presented. They include maximal performance as function of the temperature or tilt height, start-up behavior, long life tests, bended heat pipes, influence of the amount of heat carrier in 1-g-environment, and reflections on the influence of the mass of the working fluid in 0-g-environment. ESA

N76-32382* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THERMAL ANALYSIS OF AXIALLY GROOVED HEAT PIPES **c34**

Yasuhiro Kamotani *In* ESA Heat Pipes 1976 p 83-91 refs (For availability see N76-32374 23-31)

CSCL 20D

The liquid viscous drag and the evaporator film coefficient were determined analytically for a heat pipe with axial rectangular grooves under zero-g conditions. The liquid pressure drop and the evaporator film coefficient for an axially grooved heat pipe were found to be expressed by the functions of the meniscus angle, which makes it possible to predict its performance analytically. The performance near its capillary pumping limit is influenced by the contact angle. ESA

N76-32383 National Engineering Lab., East Kilbride (Scotland).

MANUFACTURE AND PERFORMANCE OF A WATER FILLED HEAT PIPE WITH A SINTERED COPPER WICK **c34**

I. C. Finlay, B. Loy, and D. G. Cree *In* ESA Heat Pipes 1976 p 93-101 refs (For availability see N76-32374 23-31)

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Details are given of the manufacture and performance of a heat pipe with a sintered copper wick and water as the working fluid. Characteristics of the wick measured before the heat pipe was assembled were used to predict the maximum axial heat transfer capability. When operating against a gravitation head of approximately 368 mm, the heat pipe transferred about 100 watts at an operating temperature of 100 C. Author (ESA)

N76-32384 Academy of Sciences (USSR), Moscow.

THE METHOD OF CALCULATION AND INVESTIGATION OF HIGH-TEMPERATURE HEAT PIPE CHARACTERISTICS TAKING INTO ACCOUNT THE VAPOUR FLOW COMPRESSIBILITY, FRICTION AND VELOCITY PROFILE **c34**

Y. A. Brovalsky, P. I. Bystrov, and M. V. Melnikov *In* ESA Heat Pipes 1976 p 113-122 refs (For availability see N76-32374 23-31)

The method for calculating high temperature heat pipe characteristics with the use of equations of motion, an equilibrium two-phase flow model, and experimental data on hydrodynamics of the flow is presented. It was found that this method described satisfactorily the real vapor flow in heat pipes. Good agreement was found between the calculation results and experimental data obtained during testing of sodium heat pipes of various shapes. ESA

N76-32385 Akademiya Nauk BSSR, Minsk.

HEAT PIPES: THEORY AND PREDICTION **c34**

M. M. Levitan and L. L. Vasiliev *In* ESA Heat Pipes 1976 p 123-130 refs (For availability see N76-32374 23-31)

The problem of the heat pipe performance theory can be formulated by determining the heat flux transported via the heat pipe and the resulting temperature distribution along its surface, the conditions of heat supply and removal in both the evaporator and condenser being prescribed. Assuming turbulent vapor flow a mathematical model for a steady problem of heat pipe prediction was established considering all dominant processes in both the heat pipe envelope and cavity. Using this model it is possible to calculate the maximum heat flux transported via the heat pipe. Some calculation results for a sodium heat pipe 0.5 m long and with an artery radius of 1 cm are presented varying the operating temperature conditions. ESA

N76-32386 Academy of Sciences (USSR), Moscow.

EXPERIMENTAL RADIATOR SECTION WITH HEAT PIPES: CREATION EXPERIENCE, DEVELOPMENT WORK AND LIFE TESTS **c34**

A. G. Arakelov, Y. A. Brovalsky, P. I. Bystrov, M. G. Glazunov, A. F. Gekov, I. I. Raikov, L. V. Solovyov, L. M. Reshetko, V. A. Osadchy, M. V. Melnikov et al *In* ESA Heat Pipes 1976 p 131-137 ref (For availability see N76-32374 23-31)

The experience in designing the experimental section of a radiator with a single row stack of heat pipes streamlined with the coolant plane-parallel flow was dealt with. The radiator consisted of 14 sodium filled heat pipes (18 mm diameter and 714 mm length) welded into the collector-heat exchanger of the warming heat-coolant; columbium alloy (Nb-1Zr-0.1C) was used as structural material for both the radiator and heat pipes. Thermal and life tests were carried out on single heat pipes. It is found that the radiator experimental section of 14 columbium heat pipes with sodium as working fluid functioned successfully for 7,500 hr in the 850 to 950 C lithium temperature. The tests on sodium filled columbium heat pipes showed that long service life can be ensured with cleaning of sodium and pipe working surfaces, and preventing sodium from contamination during operation. ESA

N76-32387 Odessa Technological Inst. of Food and Refrigerating Industries (USSR).

ENGINEERING METHODS OF LOW-TEMPERATURE HEAT PIPE DESIGNING CALCULATIONS **c34**

G. F. Smirnov, V. V. Barsookov, and L. N. Mishchenko *In* ESA Heat Pipes 1976 p 141-151 refs (For availability see N76-32374 23-31)

Engineering methods of designing calculations and a mathematical model of start-up conditions for gas-controlled and non-controlled low-temperature heat pipe operation were developed and an example of designing calculations for a cooling system with heat pipes is demonstrated. Author (ESA)

N76-32388 Reading Univ. (England). Engineering and Cybernetics Dept.

DYNAMIC CHARACTERISTICS OF HEAT PIPES **c34**

G. Rice and E. Azad *In* ESA Heat Pipes 1976 p 153-164 refs (For availability see N76-32374 23-31)

The dynamic response of a heat pipe at start-up or variable thermal input under buffered conditions relates to various properties of the working fluid. Both water and sodium charged heat pipes were tested with air and helium buffering, respectively. The experimental determination of dynamic response of each heat pipe, under varying operating conditions, was compared to theoretical predictions. The sodium heat pipe was heated by a fluidized bed combustion system since the study was aimed at establishing the start-up time for a fluidized bed/heat pipe energized Stirling engine under development. Problems associated with high rates of extraction of heat from a fluidized bed, by use of heat pipes, create the basic problem of maximizing surface to volume ratio for heat transfer. This is seen to involve the use of multi-limb heat pipe design. Tests were undertaken to establish the difference in start-up conditions of multi-limb thermosiphon and heat pipe designs. The apparatus was constructed in glass, with acetone as the working fluid, to allow for visual observation to determine the influence of variable thermal input to the limbs on migration of the working fluid. Author (ESA)

N76-32389* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HEAT PIPES FOR SPACECRAFT TEMPERATURE CONTROL: AN ASSESSMENT OF THE STATE-OF-THE-ART **c33**

M. Groll and J. P. Kirkpatrick *In* ESA Heat Pipes 1976 p 167-181 refs (For availability see N76-32374 23-31)

CSCL 20D

Spacecraft applications that require the efficient cooling of high-powered components, the precise temperature control of sensitive electronic and optical components, and the protection of cooled components from temporary, adverse environmental conditions are increasing. Heat pipes using gas, vapor, liquid, or voltage control to provide variable conductance or diode thermal behavior have been and are continuing to be developed to meet increasingly difficult requirements. The various control techniques are critically evaluated using characteristic features and properties,

including heat transport capability, volume and mass requirements, complexity and ease of fabrication, reliability, and control characteristics. As a result, advantages and disadvantages of specific approaches are derived and discussed. Using four development levels, the state-of-the-art of the various heat pipe temperature control techniques is assessed. Author (ESA)

N76-32390* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF AXIAL GROOVES TO CRYOGENIC VARIABLE CONDUCTANCE HEAT PIPE TECHNOLOGY c33
Patrick J. Brennan (B and K Eng., Inc.) and Manfred Groll *In* ESA Heat Pipes 1976 p 183-195 refs (For availability see N76-32374 23-31)
CSCL 20D

Tests results obtained with an ATS axial groove aluminum extrusion adapted for use as a cryogenic thermal diode and/or a variable conductance heat pipe are presented. Ethane at a nominal operating temperature of 185 C was used as working fluid. In addition to both active and passive gas control, diode designs utilizing gas blockage or liquid trap were investigated. Specific requirements and performance parameters such as transient behavior, reservoir sizes, shutdown energy, etc., were evaluated. Results are also presented for tests where the liquid trap was used as a secondary heat pipe to demonstrate thermal switching with simultaneous heat pipe operation and diode shutdown. ESA

N76-32391 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
DEVELOPMENT OF A PASSIVE HOT GAS RESERVOIR VARIABLE CONDUCTANCE HEAT PIPE c34
W. D. Muenzel, M. Groll, and M. Hage *In* ESA Heat Pipes 1976 p 197-205 refs (For availability see N76-32374 23-31)

The preliminary and final designs of a passive gas-controlled Variable Conductance Heat Pipe (VCHP) employing a hot nonwicked reservoir to provide a close temperature control of a microwave source oscillating at 13.26 Hz and to be used for space applications are analyzed. In selecting a suitable VHCP concept for the considered task, the demand for no additional electrical power for thermal control purposes was one of the most important constraints. The VHCP was to maintain the microwave source at a design temperature of 60 C for varying both sink temperature from 5 to 35 C and dissipated power from 4 to 8 W, respectively. ESA

N76-32392 Akademiya Nauk BSSR, Minsk.
HEAT AND MASS TRANSFER IN CRYOGENIC GAS-LOADED HEAT PIPES c33
L. L. Vasiliev, S. V. Konev, A. M. Marchenko, A. D. Shnyryov, I. S. Desyukevich, and V. V. Gill *In* ESA Heat Pipes 1976 p 207-213 refs (For availability see N76-32374 23-31)

Physical properties of the main components of a heat pipe vary at cryogenic temperature, which significantly affects heat and mass transfer. It is shown that to attain large temperature sensitivity factors and enhanced heat transfer on the condenser surface, the condensation section of a heat pipe envelope should be made of a material with high thermal resistance in the axial direction and low thermal resistance in the radial one. In order to confirm peculiarities of cryogenic heat pipe operation, three cryogenic gas loaded heat pipes were constructed and an attempt was made to study the temperature sensitivity factor. ESA

N76-32393 Pisa Univ. (Italy). Ist. di Fisica Generale ed Applicata.
HEAT PIPES AT THE RANGE OF MODERATE TEMPERATURES WITH GAS PRESENCE c34
C. Casarosa and E. Latrofa *In* ESA Heat Pipes 1976 p 215-224 refs (For availability see N76-32374 23-31)

The behavior of a gas-loaded heat pipe was analyzed using a simplified model of heat conduction for inert gas zone. The experimental apparatus is described and experimental results discussed. It is shown that in the case of the average external heat transfer coefficient, the evaluation of data verifies the validity of the models (model for radial conduction in series and model for axial conduction in parallel) provided for the determination of the equivalent conductivity of saturated porous structures in series or in parallel. ESA

N76-32394 Naval Postgraduate School, Monterey, Calif.
EFFECTS OF GRAVITY ON GAS-LOADED VARIABLE CONDUCTANCE HEAT PIPES c34
Matthew D. Kelleher and William H. Batts *In* ESA Heat Pipes 1976 p 225-234 refs (For availability see N76-32374 23-31) (Grant NSF AG-496)

The effects of gravity on the operation of gas-loaded variable conductance heat pipes was investigated. Experimental results were obtained for two heat pipes (1.6 cm and 5 cm diameter) operating with methanol as the working fluid and krypton or helium as the control gas. Results show that gravity tends to distort the axial temperature profiles on the small diameter pipe. For the larger diameter pipe gravity has the effect of causing a stratification of the working fluid and noncondensable gas. These results seem to indicate that in certain cases the presently available design procedure will have to be modified to account for the effects of gravity on variable conductance heat pipe operation. Author (ESA)

N76-32395 European Atomic Energy Community, Ispra (Italy).
MEASUREMENT OF THE ISOTHERMALITY OF A GAS CONTROLLED HEAT PIPE c34
J. P. Labrande *In* ESA Heat Pipes 1976 p 235-244 refs (For availability see N76-32374 23-31)

Temperature measurements were made in a channel passing through the axis of an argon-controlled heat pipe (copper/water, 50 cm long). One end of the heat pipe is cooled and connected to the gas control system; the rest is divided into four consecutive heating zones, which can be used at choice. A differential measurement method with permutation of the temperature sensors (platinum resistances) is employed, having a sensitivity of 0.0002 C. At sufficiently high power inputs, fairly isothermal regions with a temperature homogeneity of 0.001 C, up to 30 cm long, are found outside of the chosen heating zone. Inside the heated region a nonreproducible temperature increase (up to about 0.01 C) is observed. When one of the two middle heating zones is used, isothermal plateaus occur on both sides of it, but with different temperatures. The phenomenon is explained by different argon concentrations on both sides of the evaporator. The analysis indicates considerable gas entrapment in the condensation process and the existence of an essentially gas-free vapor on the far side of the evaporator with respect to the gas plug. Author (ESA)

N76-32396 Bell Telephone Labs., Inc., Naperville, Ill.
A VARIABLE CONDUCTANCE HEAT PIPE USING BUBBLE PUMP INJECTION c34
Charles C. Roberts, Jr. *In* ESA Heat Pipes 1976 p 269-280 refs (For availability see N76-32374 23-31)

Variable thermal conductance can be achieved in a heat pipe by controlling liquid flow through the use of a bubble pump. A bubble pump is a liquid-filled tube in the vertical position which lifts liquid against gravity when heat is supplied at the portion containing liquid. If the bubble pump is attached to the evaporator portion of a heat pipe, a means of varying liquid flow to the heat pipe evaporator exists when control heat is applied to the bubble pump. Three variable conductance concepts are discussed: on-off operation, active feedback, and passive feedback. Evaporator temperature control varied from + or - 2 to + or - 20 C depending on bubble pump design. Various bubble pump configurations were tested, and experimental data are presented concerning injection duty cycle, injection volume control, injector heating position, and thermal control capability at various heat loads. Author (ESA)

N76-32397* Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.
PERFORMANCE CHARACTERISTICS OF ROTATING WICKLESS HEAT PIPES c34
P. J. Marto *In* ESA Heat Pipes 1976 p 281-291 refs Sponsored in part by NASA and Naval Sea Systems Command (For availability see N76-32374 23-31)

A theoretical model was derived for laminar film condensation on the inside of a rotating, truncated cone which includes the effects of vapor shear and vapor pressure drop. Results are

compared to those of previous investigations. Experimental data are presented for rotational speeds of 700, 1,400, 2,100, and 2,800 rpm using water, ethyl alcohol, and Freon 113 as working fluids. Agreement between theory and experiment is within + or - 20 percent. Author (ESA)

N76-32398 Akademiya Nauk BSSR, Minsk.
CENTRIFUGAL COAXIAL HEAT PIPES **c34**
L. L. Vasiliev and V. V. Khrolenok *In* ESA Heat Pipes 1976 p 293-302 refs (For availability see N76-32374 23-31)

The performance of a centrifugal heat pipe designed for cooling of bodies of revolution, heating of liquids, etc., including the choice of liquid, was investigated theoretically and experimentally. The experimental installation consisting of a stainless steel heat pipe 102 x 2 mm (external diameter), 35 x 2 mm (internal diameter) and 400 mm (length), nichrome heater, and an electric motor, is described. Performance characteristics obtained from experiments are presented and discussed. ESA

N76-32399 University Coll. of Swansea (Wales). Mechanical Engineering Dept.
THEORETICAL AND EXPERIMENTAL ANALYSIS OF NON-CONDENSABLE GAS EFFECTS IN A ROTATING HEAT PIPE **c34**
T. C. Daniels and R. J. Williams *In* ESA Heat Pipes 1976 p 303-314 refs (For availability see N76-32374 23-31)

A fully predictive theory based on mass, momentum, and energy conservation principles was formulated to provide heat transfer results and to furnish insight into the mechanism by which the noncondensable gases inhibit the heat flow in heat rotating heat pipes. The predictions of the analysis are subjected to a comparison with experimental work. The analysis concerning the condenser portion of a rotating heat pipe was carried out for a pair of interacting boundary layers, an inner one consisting of a liquid condensate phase and an outer one of a vapor gas mixture. The analysis considers separately the liquid and vapor-gas boundary layers and then couples them together by using compatibility conditions at the interface, the rate of condensation and heat transfer being determined by the interaction between these layers. ESA

N76-32400 Fairchild Space and Electronics Co., Germantown, Md.
PERFORMANCE OF HEAT PIPE ROTATING ABOUT THE VERTICAL AXIS AND ITS APPLICATION TO A SPINNING SPACECRAFT **c19**
Han Hwangbo, Robert J. Eby, and Robert S. Rovinski (NRL) *In* ESA Heat Pipes 1976 p 315-324 refs (For availability see N76-32374 23-31)

An application of the axial groove heat pipe to the thermal control of a spacecraft during spin stabilization orbit was evaluated. The heat pipes rotate about a perpendicular axis (spacecraft spin axis) and transfer heat from an external solar collector plate to a spacecraft equipment deck. During the mission, the heat pipes operate either in a reflux or reverse mode. Thus the axial acceleration fields due to rotation will either aid or hinder circulation of the working fluid. An ammonia heat pipe was constructed and subjected to controlled acceleration tests on a laboratory centrifuge. The effects of the axial and the perpendicular components (gravitational and Coriolis) of the acceleration forces on the heat pipe performance were evaluated and experimental results are presented. Observations pertaining to the maximum acceleration field in which a heat pipe will perform when the heat load or heat sink temperature is varied are given. Author (ESA)

N76-32401 European Atomic Energy Community, Ispra (Italy).
THE GAS CONTROLLED HEAT PIPE AS A TOOL FOR WETTING STUDIES **c34**
M. Bader *In* ESA Heat Pipes 1976 p 327-334 refs (For availability see N76-32374 23-31)

A new method is presented for measuring the wetting angle at high temperatures and vapor pressures; it consists of a combination of the classical sessile drop method with a gas buffered heat pipe. A T-shaped heat pipe with two gas buffers was built specifically for the study of sodium wetting. The experience gained from its operation is reported. It is concluded that the gas buffered heat pipe is well suited to overcome the temperature limitations of the present methods of wetting angle measurements. The gas plug gives very efficient protection of observation windows and feed-throughs provided a stable gas-vapor stratification is realized; however, the new method can be limited by the optical transparency of the vapor of the metal under study. In the case of sodium, this limit lies for incandescent light at about 720 C, i.e., about 200 C above the upper temperature limit of the present methods. Author (ESA)

N76-32402 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
INVESTIGATION OF CAPILLARY FORCES AND SURFACE TENSION **c34**
W. Molt *In* ESA Heat Pipes 1976 p 335-346 refs (For availability see N76-32374 23-31)

The forces of surface tension and associated capillary phenomena applied to heat pipes were investigated. The following aspects for use in heat pipe design are discussed: a literature compilation to obtain empirical formulae describing temperature dependence of surface tension and establishing the applicability range of these relationships by comparisons to existing data; capillary rise in arterial wicks with and without gas bubbles; capillary rise in axial grooves having rectangular and trapezoidal cross-sections. Author (ESA)

N76-32403 European Atomic Energy Community, Ispra (Italy).
CORROSION STUDIES OF TUNGSTEN HEAT PIPES AT TEMPERATURES UP TO 2650 C **c34**
F. Geiger and D. Quataert *In* ESA Heat Pipes 1976 p 347-356 refs (For availability see N76-32374 23-31)

Heat pipe corrosion tests up to 2,650 C were made using CVD-W as wall material and Ag, Au, Cu, Ga, Ge, In and Sn as working fluids. In most of the heat pipes a strong mass transport was observed, which is attributed both to solubility and thermochemical impurity corrosion. The material combination W/Ag turned out to be most promising. After a test of app. 6 h at 2,420 C no mass transport could be detected; however, from the observed intergranular penetration of Ag into the wall of the condensation zone, the lifetime of this heat pipe is estimated to be limited to about 25 h. As the intergranular corrosion may have been enhanced by the columnar structure and the porosity of the utilized CVD-W, longer lifetimes could possibly be obtained with W of improved quality. Author (ESA)

N76-32404 Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
COMPATIBILITY AND RELIABILITY OF HEAT PIPE MATERIALS **c34**
A. Basiulis, R. C. Prager, and T. R. Lamp *In* ESA Heat Pipes 1976 p 357-372 refs (For availability see N76-32374 23-31)

To predict the long life capabilities of heat pipes, a life test program was begun eight years ago to evaluate potential heat pipe fluids. Fluids tested range from those suitable in cryogenic applications to those of use in high temperature heat pipes. Stainless steel proved to be acceptable for long term use with all common low temperature fluids except water, which requires copper or monel. Failures were usually caused by material incompatibility or improper cleaning and processing, although breakdown of some high molecular weight organic fluids under heat pipe operating conditions was encountered. Author (ESA)

N76-32405 European Space Research and Technology Center, Noordwijk (Netherlands).
DEVELOPMENT OF ARTERY HEAT PIPES IN EUROPE UNDER ESA SPONSORSHIP **c34**
C. J. Savage *In* ESA Heat Pipes 1976 p 373-381 refs (For availability see N76-32374 23-31)

The program on development of lightweight artery designs suitable for use in space radiators is briefly described. The program includes heat pipe development, flight qualification, flight tests, life testing, and degradation studies. The use of both acetone and ammonia as working fluids was investigated. It is concluded that investigations into deterioration in acetone and aluminum heat pipes have cast doubt on the long term compatibility of these materials and emphasized the need to exclude all traces of water from the system; persistent gas generation has been experienced in ammonia heat pipes constructed of aluminum with stainless steel wicks; pipes made of one metal only have

proved more resistant; no deterioration has been observed in the stainless steel pipes, and small amount of gas has appeared in the aluminum ones. ESA

N76-32406 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
LIFETESTS OF ARTERY HEAT PIPES FOR LOW TEMPERATURE RANGE **c34**
W. D. Muenzel and C. J. Savage *In* ESA Heat Pipes 1976 p 383-392 refs (For availability see N76-32374 23-31)

Bendable low temperature heat pipes of the double artery type developed at IKE under ESTEC contract and flight-tested aboard a sounding rocket as the ESRO experiment included in the international heat pipe experiment were demonstrated to be useful components for potential applications in spacecraft thermal control. These heat pipes employ a flight qualified concept and exhibit an excellent heat transport capability using ammonia as the working fluid. To prove the compatibility of the working fluid with the structural materials, lifetests on six aluminum/stainless steel/ammonia heat pipes, extending over a total duration of 3 years, were started at IKE under ESTEC contract in May 1974. Since there was evidence of gas generation within these Al/SS/NH3 heat pipes, two of them were replaced after 15 months of operation by all stainless steel heat pipes. In addition, two double artery type heat pipes constructed from aluminum using ammonia as the working fluid were subjected to lifetesting. Author (ESA)

N76-32407 International Research and Development Co. Ltd., Newcastle (England).
THE FORMATION OF DIACETONE ALCOHOL DURING LIFE TESTS ON ACETONE HEAT PIPES CONSTRUCTED USING ALUMINIUM AND STAINLESS STEEL **c34**
D. A. Reay and M. P. Johnson *In* ESA Heat Pipes 1976 p 393-399 (For availability see N76-32374 23-31)

As part of a program to develop heat pipes for a telecommunications satellite application, life tests were carried out on heat pipes using acetone as the working fluid, with aluminum alloy wall material and a stainless steel wick. Following life tests extending over a period of 17,500 hr, with the vapor temperature maintained between 75 and 80 C, examination of the working fluid showed that diacetone alcohol was present in all the test units. Diacetone alcohol results from aldol condensation of acetone, and this alcohol also reacts to form water, which is incompatible with aluminum. This may obviously be significant when considering acetone/aluminum heat pipes for operation in the test temperature range. Recommendations are also given for life test procedures. Author (ESA)

N76-32408 Institute of Physics and Power Engineering, Obninsk (USSR).
EVAPORATION OF LIQUID METALS FROM CAPILLARY POROUS BODIES **c34**
V. I. Subbotin, M. N. Ivanovski, A. P. Kudryavtsev, V. V. Prosvetov, V. P. Sorokin, D. N. Sorokin, and L. M. Prorok *In* ESA Heat Pipes 1976 p 403-411 refs (For availability see N76-32374 23-31)

Based on a simplified theory of gases some expressions were obtained for additional pressure drops arising at evaporation and condensation which should be taken into account when determining the maximum heat transfer of heat pipes. Superheating required for boiling has been shown to be constituted of superheating due to the heat flow passing through the wick (superheating due to heat conduction), superheating due to stretching of liquid at distortion of the liquid-vapor surface (capillary superheating), and superheating due to evaporation (phase superheating). An important condition for the high power heat pipe operation was noted. If the vapor nucleation site sizes be comparable with or larger than those of the wick pores, the capillary limit of power transferred by a heat pipe will not be reached and the crisis will take place because of boiling. Experimental data obtained at sodium evaporation reveal that crisis phenomena caused by pressure at the phase interface are characteristic of fine-porosity screens and that boiling within the wick is likely to take place at lower liquid-metal superheatings than under conditions of natural convection and smooth wall. It has been shown by experiments that at alkali metals evaporation from wicks an extremely intensive heat removal can be achieved. Substantial heat fluxes of 910 W/sq cm reached in the tests were not critical and can be further increased. Author (ESA)

N76-32409 North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
THE MECHANISM OF HEAT TRANSFER IN THE EVAPORATOR ZONE OF THE HEAT PIPE **c34**
H. M. Winston, J. K. Ferrell, and R. Davis *In* ESA Heat Pipes 1976 p 413-423 refs (For availability see N76-32374 23-31)

By combination of mass, energy, and momentum balances over a planar heat pipe wick, an equation to predict the critical heat flux of capillary flow limited heat pipes can be developed. This equation has been demonstrated to predict accurately the critical heat flux of liquid metal filled wicks and to overpredict the critical heat flux of wicks used with a nonmetallic working fluid above a heat flux of 94,600 J/sq m.sec. A revised equation taking into account vapor friction in the wick structure was considered and used to predict the critical heat flux of wicks filled with water as working fluid. The mode of evaporative heat transfer in the evaporator zone of the heat pipe was found to be dependent upon the type of working fluid. When liquid metal working fluids are used, heat is transferred by conduction across a liquid-saturated wick to the wick outer surface where vaporization of the working fluid takes place. When nonmetallic working fluids are used, heat is transferred by conduction to a liquid-vapor interface which exists within the wick structure. The wicks studied were fabricated from beds of packed beads or planar slabs of sintered metal fibers and powders. Liquid potassium at a saturation temperature of 866 K (16,800 N/sq m) and water at atmospheric pressure were utilized as working fluids. Author (ESA)

N76-32410 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
EVAPORATION HEAT TRANSFER IN HEAT PIPES **c34**
R. R. Barthelemy *In* ESA Heat Pipes 1976 p 425-436 refs (For availability see N76-32374 23-31)

To determine the heat transfer characteristics in the evaporator zone of a heat pipe and to examine actual heat pipe operating phenomena a heat pipe design was used for all heat pipe tests. An everted design utilizing radial heat transfer through the metallic inner cylinder and having a glass outer containment cylinder which allowed visual and diagnostic observations was employed. Infrared thermal detection and high magnification visual observation was used to observe density variations, boiling and dryout phenomena in the wicks. In addition, extensive temperature measurements were carried out. The goal of the program was to construct more accurate models from experimental data for predicting the heat transfer coefficients and critical heat rate for the heat transfer process occurring in the evaporator section of the heat pipe. It is recommended that further study should be conducted of the mechanism of evaporation in heat pipes. ESA

N76-32411 Q-dot Corp., Dallas, Tex.
HEAT PIPE THERMAL RECOVERY UNIT APPLICATIONS **c34**
M. A. Ruch and G. M. Grover *In* ESA Heat Pipes 1976 p 439-449 (For availability see N76-32374 23-31)

The heat pipe is an evaporation/condensation device which can transfer large quantities of heat with very small temperature differences. A multiplicity of heat pipes arranged as a counterflow heat exchanger between two airstreams finds useful applications in thermal energy recovery. Three general classes of applications can be identified: using energy recovered from process exhaust to regenerate the process; using energy from process exhaust to heat comfort make-up air during the winter months; and, using comfort exhaust to preheat comfort make-up air during the winter months and/or precool comfort make-up air during the summer months. Installations of each class are described. As of the present date, over 1000 units involving approximately 125,000 heat pipes have been installed. Under nominal operating conditions, this represents an energy saving of nearly a million barrels of oil equivalent per year. Author (ESA)

N76-32412 New Mexico Univ., Albuquerque.
PRELIMINARY DESIGN STUDY OF HEAT PIPE HEAT EXCHANGERS **c34**

K. T. Feldman and D. C. Lu *In* ESA Heat Pipes 1976 p 451-461 refs (For availability see N76-32374 23-31)

A preliminary design study was conducted in order to identify the important design parameters which can be varied to optimize overall performance of heat pipe heat exchangers. A computer program was developed to analyze the heat exchanger performance using conventional design procedures for finned tube heat exchangers and using conventional design procedures for three-puddle-artery heat pipes. ESA

N76-32413 Akademiya Nauk BSSR, Minsk.
STUDY OF HEAT AND MASS TRANSFER IN HEAT PIPE BASED EXCHANGERS **c34**
L. L. Vasiliev, L. P. Grakovich, A. N. Abramenko, O. G. Rasin, P. A. Vityaz, M. A. Litvinetz, and V. G. Kiselev *In* ESA Heat Pipes 1976 p 463-472 ref (For availability see N76-32374 23-31)

To choose the optimal structure of heat pipe heat exchangers, capillary structures in the form of grooved-type thin film evaporators were investigated, as well as a suitable working fluid for heat exchangers. Different kinds of capillary structures, liquids, and their mixtures were chosen; and the parameters of the heat pipes and of the two-phase thermosiphon were compared. Two types of heat exchangers on heat pipes with liquid-gas systems were considered: a heat exchanger composed of separated gas-loaded heat pipes and a heat exchanger having a common cavity, evaporator, and condenser made of rows of finned tubes connected at the top to a common volume for a noncondensable gas. The investigation revealed the potential of a liquid-gas exchanger on heat pipes. With vertical position of heat exchangers, both heat pipes and two-phase thermosiphons can be used in the gravity field. As a general rule thermal resistance of heat pipes is less than that of thermosiphons. An optimal structure is suggested. ESA

N76-32414 Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
FOLLOW-UP ON HEAT PIPE APPLICATIONS **c34**
A. Basiulis *In* ESA Heat Pipes 1976 p 473-480 refs (For availability see N76-32374 23-31)

Heat pipes which are no longer experimental devices and have been in actual field use for a period of a year or more are presented. Four heat pipe types are reviewed: simple axial heat pipes used in electron component cooling applications, blow molding machines for plastic bottle manufacture, and heat recovery; vapor chambers applied to liquid fuel fired griddle developed for the Army; gas buffered heat pipes used to provide constant temperature platform, etc.; and open loop heat pipes designed as cryosurgical instruments. ESA

N76-32415 Atomic Weapons Research Establishment, Aldermaston (England). Microcircuit Technology Group.
AN INTEGRAL HEAT PIPE PACKAGE FOR MICROELECTRONIC CIRCUITS **c34**
D. J. Dean *In* ESA Heat Pipes 1976 p 481-502 refs Sponsored in part by Dept. of Trade and Ind. (For availability see N76-32374 23-31)
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There is a general degradation in microcircuit reliability associated with increasing component temperatures. The small size of the heat generating components in microcircuits increases the problem of heat removal, and thus the ability of a heat pipe to act as an area or heat flux transformer makes it an attractive proposition for microcircuit cooling. An integral heat pipe is described which reduces the temperature gradients associated with standard pipes by housing the microcircuits in contact with the working fluid instead of being bolted on the outside of the pipe. It is shown that such a pipe can dissipate more than twice the power which could be dissipated in free air and requires a third of the temperature differential. In order to facilitate assembly, a prefabricated cushion wick structure was developed which can be pretested and repaired before final assembly; this wick can be made in many unusual geometries and is not restricted to microelectronic applications.
Author (ESA)

N76-32416 National Research Inst. for Machine Design, Bechovice (Czechoslovakia). Research Inst. for Rotating Electrical Machines, Brno.
COOLING OF ELECTRICAL MACHINES BY HEAT PIPES **c34**
O. Oslejsek and F. Polasek *In* ESA Heat Pipes 1976 p 503-514 refs (For availability see N76-32374 23-31)

A survey of construction possibilities and up-to-date known applications of heat pipes to cool electrical machines is presented. Methods used for cooling electrical machines including gravitational (closed two-phase thermosiphons) heat pipes, rotating coaxial pipes, and capillary pipes are described. Experimental results of an electric motor cooled using coaxial rotating heat pipes are presented. Experimental results of coaxial rotating heat pipes applications for cooling serial mean size induction motors as well as some special induction motors (variable-speed induction motor with solid motor, ac induction motor with frequency-speed regulation, and ac induction motors of small built-in sizes) are presented and the cooling efficiency determined. ESA

N76-32417 B & K Engineering, Inc., Towson, Md.
APPLICATION OF HEAT PIPES TO DEICING SYSTEMS **c44**
Henry J. Suelau, Edward J. Kroliczek, and Charles Philip Brinkman (Dept. of Transportation, Washington, D. C.) *In* ESA Heat Pipes 1976 p 515-527 refs (For availability see N76-32374 23-31)

Various applications of heat pipe deicing systems including roadway and ramps, bridges and overpasses, and airport runways are introduced. Particular attention is paid to parameters relating to deicing systems using individual heat pipe elements for earth heat extraction and pavement distribution. The systems analysis developed for this configuration can be applied with slight modification to all heat pipe deicing installations. The basic procedure for designing a heat pipe deicing system is as follows: define heating requirements, determine the capacity of the earth heat source, define augmentation and/or control methods if required, and perform a systems analysis to determine the most cost-effective method of heat collection and distribution which will satisfy heating requirements. Author (ESA)

N76-32418 National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
SELF DE-ICING NAVIGATION BUOYS USING HEAT PIPES **c34**
B. S. Larkin and S. Dubuc (Min. of Transport) *In* ESA Heat Pipes 1976 p 529-535 refs (For availability see N76-32374 23-31)

Ice formation on navigation buoys is a serious problem on Canada's east coast. The ice is formed by ocean spray when there is an appropriate combination of strong wind and low air temperature; it can accumulate to such an extent that the buoy capsizes. Previously the ice has been removed by men who hang on to the buoy with one hand and chop the ice away with an axe. One possible solution is to use the heat pipe principle to transport heat from the sea, i.e. the condensing section is the above water surface where the ice forms and the heated section is under water extracting heat from the sea. The temperature difference available is small; the sea temperature can drop to -1 C and the freezing point of sea water is -2.2 C. Ammonia was chosen as the working fluid. For simplicity, a wickless heat pipe (or thermosiphon) was used. Laboratory tests were carried out to measure the heat transfer coefficients in the falling film mode for ammonia and mild steel, with small temperature differences at a mean temperature just above 0 C. Prototype buoys were designed for ocean testing leading to a new design making use of the heat pipe deicing, this buoy will be stationed in the sea off Halifax, Nova Scotia, during the winter 1975-1976. Author (ESA)

N76-32419 European Atomic Energy Community, Ispra (Italy).
A PRESSURE CONTROLLED PRECISION THERMOSTAT **c34**
C. Bassani and C. A. Busse *In* ESA Heat Pipes 1976 p 537-544 refs (For availability see N76-32374 23-31)

For absolute viscosity measurements a precision thermostat was developed making use of two coupled gas controlled heat pipes. Stainless steel is used for wall material, Freon 11 or water as working fluid, and argon as control gas. The thermostatic chamber is 20 cm in diameter and 50 cm long. Measure-

ments of the temperature distribution were performed between 20 and 140 C. The results show a great temperature homogeneity; variations of less than + or - 0.005 C were observed over the whole chamber. Passage from one temperature level to another is easy and fast (about 30 min for a transition of 50 C). Very great constancy of the chosen temperature level (about + or - 0.0015 C) was obtained during hours of negligible pressure drift. Compensation of pressure drift by manual control, however, was generally not possible within such narrow temperature limits; the reason is statistical pressure fluctuations, which make it difficult to recognize pressure drifts sufficiently early and which need further study in order to find ways to minimize them. It is concluded that gas controlled heat pipe thermostats, which could be realized with available technology from liquid N2 to more than 2000 C, hold great promise for all applications where temperature criteria are of prime importance, such as precision measurements of thermophysical properties, temperature standards, crystal growth, or phase transition studies.
Author (ESA)

N76-32420 National Engineering Lab., East Kilbride (Scotland).
PERFORMANCE OF A PROTOTYPE ISOTHERMAL OVEN FOR USE WITH AN X-BAND MICROWAVE NOISE STANDARD **c34**
I. C. Finlay, D. G. Cree, and D. Blundell (Roy. Radar Estab.) *In* ESA Heat Pipes 1976 p 545-553 refs Sponsored in part by Natl. Phys. Lab. (For availability see N76-32374 23-31)
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Details are given of the design, manufacture, and performance of a prototype isothermal oven designed to house the load element and associated waveguide of an X-band microwave thermal noise standard. Author (ESA)

N76-32421 AGIP Nucleare, Bologna (Italy).
ANALYSIS AND EXPERIMENTAL EVALUATION OF THE CHARACTERISTICS OF WATER AND SODIUM ANNULAR HEAT PIPES **c34**
G. Grassi, P. G. Grassi, D. Monari, G. Coggiola (Ist. di Metrologia G. Colonnetti), L. Crovini (Ist. di Metrologia G. Colonnetti), and R. Perissi (Ist. di Metrologia G. Colonnetti) *In* ESA Heat Pipes 1976 p 555-571 refs (For availability see N76-32374 23-31)

The results of an experimental investigation on annular (water and sodium) heat pipes are described. The possibility of their utilization for the characterization of thermocouple wire, from the thermoelectric power homogeneity point of view, is established. The results of this investigation indicate that a very good temperature homogeneity is obtained in the inner tube of annular water and sodium heat pipes and that a sufficiently high temperature gradient is achieved in the annular heat-pipe ends. Further investigation is suggested utilizing an annular heat-pipe special testing apparatus to define the optima thermogradients necessary to characterize the thermocouple wires from the thermoelectric power homogeneity point of view. Author (ESA)

N76-32422 European Atomic Energy Community, Ispra (Italy). Applied Mechanics Div.
DESCRIPTION OF DIFFERENT LEAKTESTS WITH STATIC MET-X SEALS, USING HEAT PIPES **c34**
L. Verheyden and K. Klein *In* ESA Heat Pipes 1976 p 573-579 refs (For availability see N76-32374 23-31)

In order to have a true idea of the behavior of seals in their final application, expensive loop tests were constructed in which a number of interesting seals were mounted. Seals were tested in these loops using circulating water with a well-known pH, organic coolants, sodium, or other liquid metals. Circulation is provided by pumps and if the working temperature should be higher than room temperature, heating power is provided usually through an electrical resistance wire which surrounds the tubing. In order to obtain results similar to those given by the rather complex test loops, vertical heat-pipes utilizing the real fluid for testing static seals are currently being used. Four different leak-tests with static seals incorporated in a heat-pipe are described in the following review. The static seals used are MET-X seals. The experiments are aimed at obtaining knowledge, on the one hand, on the behavior of the seals in Na and in Li environments and, on the other hand, on the influence of endurance tests on the leaktightness characteristics of seals made of well-known materials. Long duration tests have to be performed because the complicated profile of the MET-X seal does not allow predictions on the creep behavior on the basis of the creep characteristics of the seal material. Author (ESA)

N76-32423 Nijmegen Univ. (Netherlands). Dept. of Dermatology.
HEAT TRANSFER ACROSS THE HUMAN SKIN: THE APPLICATION OF HEAT PIPE THEORY TO PREDICT RESTING SWEAT GLAND PERFORMANCE **c34**
F. A. J. Thiele and D. A. Reay (Intern. Res. and Develop. Co. Ltd., Newcastle-upon-Tyne, Engl.) *In* ESA Heat Pipes 1976 p 581-585 refs (For availability see N76-32374 23-31)

There is evidence that the 'resting' eccrine sweat gland functions in human thermoregulation. Observations of the rest sweat gland (ie, one which is not secreting water onto the surface of the skin) indicate that the flow of liquid (and ions) in the sweat duct can take place from the skin surface to the gland. A model is proposed which caters for subsurface evaporation of sweat in the duct and condensation closer to the skin surface. This model is believed to be equivalent to the heat pipe, and the heat transported in each sweat duct may be quantified using the heat pipe theory. The predicted values are of the correct order of magnitude when compared with the resting human metabolism. Author (ESA)

N76-32424* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTERNATIONAL HEAT PIPE EXPERIMENT **c34**
Roy McIntosh, Stanford Ollendorf, and William Harwell (Grumman Aerospace Corp., Bethpage, N. Y.) *In* ESA Heat Pipes 1976 p 589-591 (For availability see N76-32374 23-31)
CSCL 20D

The aims of the experiment are outlined. Flight experiments included in this program were provided by NASA, Goddard Space Flight Center, ESA (European Space Agency), the German Ministry of Technology, Hughes Aircraft Company and NASA, Ames Research Center. ESA

N76-32425 European Space Research and Technology Center, Noordwijk (Netherlands).
PERFORMANCE EVALUATION OF THE ESRO HEAT PIPES INCLUDED IN THE INTERNATIONAL HEAT PIPE EXPERIMENT (IHPE) **c34**
W. D. Muenzel (Stuttgart Univ.), C. J. Savage, A. Accensi, and B. G. M. Aalders *In* ESA Heat Pipes 1976 p 593-606 refs (For availability see N76-32374 23-31)

The ESRO experiment consisting of two bendable artery heat pipes was flown aboard a Black Brant sounding rocket launched on October 4, 1974 as a part of the International Heat Pipe Experiment (IHPE). The objectives of the ESRO experiment were to demonstrate and study start-up behavior, examine the thermal performance in zero-gravity and compare the zero-g performance with ground test data. Flight tests and post-flight simulation tests results for the ammonia heat pipe F1 and the acetone heat pipe F2 are presented and discussed. A simple 16 node mathematical model was prepared to describe the behavior of the ammonia heat pipe F1. Author (ESA)

N76-32426 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
SOUNDING ROCKET HEAT PIPE AND PCM THERMAL CAPACITOR EXPERIMENTS **c33**
H. Koch, J. Lorschiedter, R. Strittmatter, and P. H. Pawloski (DFVLR-BPT, Cologne) *In* ESA Heat Pipes 1976 p 607-620 (For availability see N76-32374 23-31)

A heat pipe system consisting of two heat pipes and a phase change material thermal capacitor had been tested together with other experiments within a NASA sounding rocket program. This experiment proved the reliability of heat pipes and PCM thermal capacitors in space. Furthermore the prelaunch activities of three heat pipe experiments and PCM thermal capacitor experiment which will be flown in January 1976 are described. Author (ESA)

N76-32427 Centre National d'Etudes Spatiales, Toulouse (France).
A HEAT PIPE FLIGHT TEST ABOARD A SOUNDING ROCKET **c34**

F. Galzin *In* ESA Heat Pipes 1976 p 621-627 ref (For availability see N76-32374 23-31)

A heat pipe experiment aboard the Eridan-214 Sounding Rocket in 1974 is described. Three heat pipes were tested in a zero-gravity field for a period of 320 sec with a phase change material as heat sink. The data from telemetry indicate that two heat pipes performed as predicted; the working of the third one was disturbed by a thermal leakage coming from the sounding rocket. It is concluded that the tested heat pipes can be used for space applications. In addition, the suitability of sounding rockets for testing heat pipes in zero-gravity field was demonstrated. Author (ESA)

N76-32428* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LONG TERM PERFORMANCE OF THE ADVANCED THERMAL CONTROL FLIGHT EXPERIMENT c33

Patrick J. Brennan (B and K Eng., Inc.) and Jac P. Kirkpatrick *In* ESA Heat Pipes 1976 p 629-643 refs (For availability see N76-32374 23-31)

CSCL 20D

The Advanced Thermal Control Flight Experiment (ATFE) is providing the first zero-g flight data for the performance of a thermal diode heat pipe and an electrical Feedback Controlled Heat Pipe (FCHP). The temperature stability derived from the melting and freezing of octadecane is also being evaluated in this experiment. Flight data for the different operational modes are compared to ground test data, and the performance of the individual components is analyzed. Also, the ATFE's long term behavior from launch through September 30, 1975, is evaluated. The temperature control capability of a thermal diode, phase change material, and FCHP was demonstrated over more than 500 days of flight operation and each of these components should be considered in future applications. Both the diode and FCHP transport more than 20 W in the normal and passive modes during maximum conditions. Up to 30 W has been carried by the FCHP when the auxiliary heater is applied. The 'OFF-conductance' of the diode has improved substantially in flight. A 1.4 W decrease in backflow has been realized by more complete blockage. The variable conductance behavior of the FCHP is essentially unchanged with time and relative to ground tests. Degradation of the radiator and reservoir surfaces have resulted in a partial loss of control by the FCHP during normal mode operation; however, manual control at an elevated set point has demonstrated the FCHP's ability to provide regulated temperature control to within + or - 2 C. The same pipe when operated as a passive VCHP controlled at 35 + or - 10 C with the same test conditions. Author (ESA)

N76-32429* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HEAT PIPES IN SPACE: A NASA SUMMARY c34

S. Ollendorf and R. McIntosh *In* ESA Heat Pipes 1976 p 647-653 refs (For availability see N76-32374 23-31)

CSCL 20D

Experiences derived from the development, integration, and flight of NASA spacecraft and sounding rockets are presented. They include the International Heat Pipe Experiment, OAO 3, and ATS-6. Typical flight data are presented to show the performance. ESA

N76-32430 European Space Research and Technology Center, Noordwijk (Netherlands).

ESA HEAT PIPE TECHNOLOGY PROGRAM c34

A. Accensi *In* ESA Heat Pipes 1976 p 655-660 refs (For availability see N76-32374 23-31)

The object of the ESA heat pipe technology program is to define the requirements of current and future spacecraft missions and to provide qualified heat pipes and heat pipes systems for a wide range of foreseeable spacecraft applications including heat transfer systems to interface between equipment and radiators, advanced thermal control systems (feedback controlled heat pipes, diodes), and radiators and 'cold-plates' for mounting equipment. Particular attention is paid to constant conductance heat pipes, variable conductance heat pipes and heat pipe radiators. Further studies on the deterioration of heat pipe performance after loading it with noncondensable gas and on bubble generation in order to obtain a reliable variable conductance heat pipe is envisaged. Author (ESA)

N76-32431 Dornier-System G.m.b.H., Friedrichshafen (West Germany).

DEVELOPMENT OF VARIABLE CONDUCTANCE HEAT PIPE RADIATORS c34

H. Koch and H. Kreeb *In* ESA Heat Pipes 1976 p 661-671 (For availability see N76-32374 23-31)

The design of two different heat pipe radiators for space application was analyzed. In both cases, the heat pipes are of the cold gas variable conductance type. They are constructed of axial grooved aluminum profiles. The radiator fins are welded to the heat pipes so that a good thermal contact between radiator and heat pipes is achieved. Author (ESA)

N76-32432 B & K Engineering, Inc., Towson, Md.

DEFINITION OF A CRYOGENIC HEAT PIPE EXPERIMENT c33

Edward J. Kroliczek *In* ESA Heat Pipes 1976 p 673-682 (For availability see N76-32374 23-31)

The planning of a flight experiment to verify the performance of cryogenic heat pipes in a zero-g space environment is described. A number of spacecraft were investigated as potential flight opportunities for the Cryogenic Heat Pipe Experiment including ATS-F, LANDSAT 3, and LDEF (Long Duration Exposure Facility). An experiment is being prepared for the Tiros-N satellite. Experiment package designs together with anticipated results and typical mission profiles required to meet experiment objectives were developed for each spacecraft. Limitations imposed by the spacecraft and its orbit were identified and evaluated. The major design features of each experiment package, including location on the spacecraft, size, weight, temperature, and power profiles, are summarized. ESA

N76-32433# Tetra Tech, Inc., Pasadena, Calif.

STUDY OF HYDROFOIL DESIGN FOR THE HOC Final Report, May 1975 - Mar. 1976

Okitsugu Furuya Feb. 1976 169 p refs

(Contract N00014-75-C-1058; NR Proj. 062-514)

(AD-A022861; TETRAT-TC-620) Avail: NTIS CSCL 13/10

The hydrodynamic performance of several candidate hydrofoil configurations for the proposed HOC craft is evaluated. This study includes the effects of all drag components including spray, wave, interference, induced pressure and friction drag. The effects of cavitation and ventilation on foil performance is also assessed in order to achieve a balanced design which optimizes performance. GRA

N76-32434# National Bureau of Standards, Washington, D.C.

REPORTS OF THE 60TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES Final Report

Sandra J. Edgerly, ed. May 1976 275 p Held in San Diego, Calif., 13-18 Jul. 1975

(PB-252900/6; NBS-SP-442; LC-26-27766) Avail: NTIS HC $9.00 CSCL 14B

This is a report of the proceedings (edited) of the Sixtieth National Conference on Weights and Measures, sponsored by the National Bureau of Standards, held in San Diego, California, July 13-18, 1975 and attended by state, county, and city weights and measures officials, the Federal Government, business, industry, and consumer organizations. Topics discussed include: Calibration; communication; consumer issues; grain moisture measurement; laws and regulations; measurement; metric; packaging and labeling; police radar equipment; standards; supermarket automation; weights and measures. GRA

N76-32435# Mission Research Corp., Santa Barbara, Calif.

DECISION RELATED RESEARCH ON EQUIPMENT TECHNOLOGY UTILIZED BY LOCAL GOVERNMENT: FIRE SUPPRESSION. VOLUME 3: APPENDICES A THROUGH I

Nov. 1975 320 p refs

(Contract NSF C-961)

(PB-252390/0; MRC-R-7511-1-1175-Vol-3; NSF/RA/S-75-076B) Avail: NTIS HC $9.75 CSCL 13L

An analysis of mobile fire suppression systems is presented for the purposes of developing a user's manual designed to aid

in the specification and procurement of mobile fire suppression apparatus systems. Volume 3 compiles the supporting information contained in 9 Appendices. GRA

N76-32436# Mission Research Corp., Santa Barbara, Calif.
DECISION RELATED RESEARCH ON EQUIPMENT TECHNOLOGY UTILIZED BY LOCAL GOVERNMENT: FIRE SUPPRESSION. VOLUME 1: EXECUTIVE SUMMARY
Nov. 1975 51 p refs
(Contract NSF C-961)
(PB-252389/2; MRC-R-7511-1-1175-Vol-1;
NSF/RA/S-75-076) Avail: NTIS HC $4.50 CSCL 13L

Work accomplished during Phase 1 of a two-phase project is outlined for a procedural user's manual to aid in the specification and procurement of mobile fire suppression apparatus (pumpers) systems. Phase 1 was research oriented and focused on an analysis of mobile fire suppression systems and the definition of additional work required to develop the manual. Phase 2 will address a series of experimental tasks and, finally, the development of the user's manual. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

N76-32437 State Univ. of New York, Albany.
ELECTROMAGNETIC SCATTERING BY FINITE CONDUCTING CIRCULAR CYLINDERS Ph.D. Thesis
Douglas Price Margolis 1976 171 p
Avail: Univ. Microfilms Order No. 76-19670

The state of the art of electromagnetic scattering by finite cylinders is reviewed. The formal solutions for the total fields for the infinite cylinders are presented. The principles of operation and the actual design of the electromagnetic field probes are discussed. Comparisons between the total fields for all angles around the cylinder as computed from infinite cylinder theory with the normalized results of finite cylinder experiment are presented. Magnetic field measurements give infinite cylinder results for parallel polarization and for perpendicular polarization. Whether or not the ends of the cylinder were capped was found to affect measurements on the cylindrical surface. The length of the slot in a slotted cylinder affected measurements. Measurements of the parallel polarized electric field were made over the slot and parallel to the axis for different slot angles. Scans of the perpendicularly polarized field were made over the aperture. Families of curves with certain regularities result. Some scans of the parallel polarized field were made inside the cylinder and were lower in value than those made on the surface.
Dissert. Abstr.

N76-32438 British Broadcasting Corp., Kingswood (England). Engineering Div.
CEEFAX: AN INVESTIGATION OF INTERFERENCE FROM TELETEXT DATA SIGNALS INTO THE SOUND CIRCUITS OF DOMESTIC TELEVISION RECEIVERS
N. H. C. Gilchrist Jul. 1976 8 p
(BBC-RD-1976/17) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Experimental work conducted to determine the circumstances under which a television sound signal, as received in domestic television receivers in Great Britain, is subject to 'data buzz' interference was described. This type of interference has been observed when receiving System 1 television transmission, with teletext data occupying lines 17, 18, 330, and 331 in the field-blanking interval. Tests performed on a number of domestic television receivers to assess their susceptibility to it were also reported. Author

N76-32439 California Univ., Los Angeles.
THE ANALYSIS OF DIGITAL COMMUNICATION SYSTEMS BY MOMENT SPACE METHODS Ph.D. Thesis
Robert Michael Tobin 1976 142 p
Avail: Univ. Microfilms Order No. 76-20216

An approach utilizing moment space geometry for bounding generalized moments of random variables is developed. Upper and lower error bounds for the linear pulse amplitude modulation system with bounded intersymbol interference and additive Gaussian noise are derived. These depend upon the absolute moment, the second moment, and an exponential moment of the intersymbol interference random variable. The exponential moment bounds are found to form a family of upper and a family of lower bounds, each family parameterized by an arbitrary real valued number, which permits a trade off between computational complexity and the tightness of the consequent bounds. As an application of the approach to the analysis of nonlinear systems, upper and lower error bounds for a coherent phase-shift-keyed system comprised of a cascade of an arbitrary number of bandpass hard limiters are derived. Dissert. Abstr.

N76-32440 British Broadcasting Corp., Kingswood (England). Engineering Div.
AN EXPERIMENTAL 4-PHASE DIFFERENTIAL-PHASE-SHIFT-KEYING SYSTEM TO CARRY TWO HIGH-QUALITY DIGITAL SOUND SIGNALS
M. J. Kallaway Aug. 1976 22 p refs
(BBC-RD-1976/20) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

An experimental 4-phase differential-phase-shift-keying system to carry two high-quality sound signals was described. The system has possible applications in outside broadcast links and satellite broadcasting. The system offers a good compromise between the requirements of carrier power, signal bandwidth and instrumental simplicity. The factors that led to the choice of this particular type of system are discussed in some detail. It is concluded that the performance of the experimental system in the presence of noise is within about 0-5 dB of the theoretical limit. Measurements have been made to determine the performance of individual units within the system. The most critical areas of instrumentation are identified and the effect of instrumental imperfections within these critical areas is analyzed. Author

N76-32441 British Broadcasting Corp., Kingswood (England). Engineering Div.
A CIRCULARLY-POLARISED AERIAL FOR SATELLITE RECEPTION
C. Gandy Aug. 1976 15 p refs
(BBC-RD-1976/21) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A circularly-polarized feed aerial for a 2.44m parabolic reflector was designed and constructed to form the basis of a satellite receiving station. Waveguide components and a hybrid-mode scalar-horn aerial were used, with a facility for the reception of either sense of polarization. The cross-polar isolation was found to be 30 dB, and with a 2.44 meter parabolic reflector the aerial gain was estimated to be 40 dB, the efficiency approaching 70%. Author

N76-32442# California Univ., Livermore. Lawrence Livermore Lab.
DIRECT COMMUNICATION THROUGH A CONDUCTING MEDIUM
E. F. Laine 12 Jan. 1976 8 p
(Contract W-7405-eng-48)
(UCID-16998) Avail: NTIS HC $3.50

Direct communication at voice frequencies is possible through a conducting medium both along the surface and from the surface downward. A system being developed for such communication is briefly described. To date, the system has been demonstrated succesfully in both earth and water media. Author (ERA)

N76-32443# Signals Research and Development Establishment, Christchurch (England).
OPERATION AND PERFORMANCE OF A SIMPLE MULTIMODE TRACKING SYSTEM FOR SATELLITE COMMUNICATIONS
M. Chivers Jul. 1975 39 p refs
(SRDE-75007; BR49665) Avail: NTIS HC $4.00

The results of tests on a simple multimode microwave aerial tracking system built under contract for SRDE are presented.

The equipment is described, and suggestions for an improved model are included. The system was found to operate very satisfactorily and in accordance with the specification.
Author (ESA)

N76-32444# RCA Labs., Princeton, N.J.
RADIATION IN MOS/SOS DEVICES Final Report, 1 Apr. 1974 - 30 Jun. 1975
Achilles G. Kokkas, Glenn W. Cullen, and Michael T. Duffy Feb. 1976 80 p refs
(Contract F19628-74-C-0179; AF Proj. 5638)
(AD-A022623; PRRL-75-CR-64; AFCRL-TR-75-0610) Avail: NTIS CSCL 09/1

The electrical properties of thin silicon films deposited on sapphire differ from those of bulk silicon not only because of crystalline imperfections but also because of the proximity of any point within a film to the silicon/sapphire interface. This interface often has a strong influence on SOS device characteristics, especially on the leakage current of irradiated n-channel MOS/SOS transistors. An important aspect of this program has been to define and develop experimental device structures and measurement techniques which would allow a detailed study of silicon/sapphire interfaces. The structures found most suitable for this purpose were junction field-effect transistors (JFET's) and metal-insulator-semiconductor capacitors using the sapphire substrate as gate insulator (back-gate MIS capacitors). Their design and use is described in this report. It is shown that they complement each other in establishing the pre-irradiation and post-irradiation properties of the silicon-on-sapphire films and silicon/sapphire interfaces. The parameters measured included the impurity concentration and mobility as a function of depth into the silicon films, the pre-irradiation silicon/sapphire interface charge, as well as the radiation induced interface charge and changes in the JFET channel conductance as a function of radiation dose. GRA

N76-32445# Magnavox Co., Fort Wayne, Ind.
AUTOMATIC RADIO WIRE INTEGRATION SYSTEM Final Report, Aug. 1974 - Oct. 1975
Paul F. Welty, Kenneth E. Liechty, and Frank J. Spayth Oct. 1975 146 p
(Contract DAAB07-74-C-0595; DA Proj. 1S7-62701-AN-92)
(AD-A022860; ECOM-0595-74-F) Avail: NTIS CSCL 17/2

This program resulted from a concept to provide common radio equipment for net operation and for push-to-talk mobile Radio Wire Integration (RWI) operation. Because the system operates without personnel at the access units (base) and the Mobile Subscriber Unit operates as a mobile telephone and as a net radio, the system is called Automatic Radio Wire Integration System (ARWIS). The system consists of an Access Unit (AU) and a Mobile Subscriber Unit (MSU). The Mobile Subscriber Unit (MSU) normally operates as a radio on its assigned net frequency except when it is interrogated by an Access Unit (AU) or when the mobile wishes to place a call through the AU. The system operates in three modes as follows: (1) Fully automatic operation with automatic switchboards and radios with the requisite automatic tuning; (2) Partially automatic operation using an automatic Access Unit (AU) with manual switchboards and with radios having automatic tuning or manual tuning; and, (3) The system is designed to operate in the plain text or cipher mode. GRA

N76-32446# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
MULTIWALL RADOME ANALYSIS PROGRAM Final Report, Jun. 1974 - Jun. 1975
Robert M. Blumgold Feb. 1976 75 p
(AD-A023480; AFAL-TR-75-183) Avail: NTIS CSCL 17/9

This report describes a computer analysis tool for calculating the electrical transmission and reflection properties of a multiwall radome. The radome program may be used with a suitable antenna program to estimate the effects of the radome on the antenna pattern. The analysis tool is comprised of two programs, a radome-geometry program, RADOME, and a flat-panel analysis program, WAVES2. The geometry program calculates the incidence angle for each ray (a ray represents the radiated RF power from each antenna element) at the radome wall. The output data from the geometry program, RADOME, serves as input to the flat-panel program. The flat-panel program then calculates the electrical transmission and reflection parameters of the radome for each ray. These parameters may then be used with a suitable free-space antenna pattern simulation program, and the resultant antenna pattern in the presence of the radome can be computed. Author (GRA)

N76-32447# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
VLF/LF REFLECTIVITY OF THE POLAR IONOSPHERE, 19 JANUARY - 2 MARCH 1975 Environmental Research Papers
John E. Rasmussen, Ralph J. McLain, and John P. Turtle 22 Jan. 1976 25 p refs
(AF Proj. 4603)
(AD-A022674; AFCRL-TR-76-0045; AFCRL-ERP-549) Avail: NTIS CSCL 20/14

This report provides a summary of high latitude ionospheric reflectivity as observed by the USAF's high resolution VLF/LF ionosounder operating in northern Greenland. Ionospheric reflectivity parameters, including reflection heights and coefficients, are presented as a function of time of day. VLF long path propagation measurements, along with magnetometer and riometer data, are presented as supplementary information.
Author (GRA)

N76-32448# Naval Surface Weapons Center, White Oak, Md.
SCATTERING OF ELECTROMAGNETIC RADIATION BY APERTURES. 10: THE AXIALLY SLOTTED INFINITE CYLINDER-INTERNAL AND NEAR APERTURE FIELDS. SURFACE CURRENT, APERTURE FIELD AND BSCS FOR INTERMEDIATE SLOT ANGLES
L. F. Libelo, A. G. Henney, J. N. Bombardt, and F. S. Libelo 30 Jan. 1976 118 p refs
(ER0110101; HDL Proj. E052E6)
(AD-A023470; NSWC/WOL/TR-75-162) Avail: NTIS CSCL 20/14

The calculated interior electric field distributions and the near field region exterior to the slot field distributions are presented in this report. These are the fields for the infinite circular cylinder with an axial slot irradiated at normal, symmetric incidence. In addition, results for aperture field, surface current and backscattering cross-sections are given for intermediate size slot angles. Author (GRA)

N76-32449# Institute for Telecommunication Sciences, Boulder, Colo. Inst. for Telecommunication Sciences.
NETWORK CAPACITY AND QUEUE ASPECTS OF USPS ELECTRONIC MESSAGE SYSTEMS
Peter McManamon Mar. 1976 182 p refs
(PB-252690/3; USPS-1702-114) Avail: NTIS HC $7.50 CSCL 17B

A geostationary orbit satellite communications network is developed parametrically for a 125 station application to USPS Electronic Message Service. The satellite is based on the Atlas-Centaur launch vehicle with a 9-zone antenna coverage of the continental U.S. Other multiple zone configurations are considered. Earth stations with 5.0 meter diameter antennas are assumed to have a total average traffic load of 91,312,000 messages/day. The queueing analysis is based on 4th order Erlangian arrival and service statistics with an average bits/message considered parametrically up to 1,200,000. Message delays are presented parametrically so that results for networks up to 123 stations and traffic loads up to 100,000,000 messages/day may be evaluated. For 123 stations and 617,000 bits/messages, a nearly state-of-the-art single satellite network appears feasible to support a 91,312,000 messages/day traffic load with average message transmission delays of 2.5 seconds/message or less. GRA

N76-32450# Frequency Devices, Inc., Haverhill, Mass.
DESIGN OF AN ACTIVE COC FILTER FOR AUDIO FREQUENCY SIGNAL PROCESSING Technical Report, Mar. 1973 - Dec. 1974
Robert W. Steer, James C. Rock, J. Ryland Mundie, and Donald Osborne Wright-Patterson AFB, Ohio AMRL Jan. 1976 35 p refs
(Contract F33615-73-C-4065; AF Proj. 7233)

(AD-A022903; AMRL-TR-75-78) Avail: NTIS CSCL 09/3

COC filters are signal processing devices that are comprised of a lossy, nonuniform delay line. They are used for time domain analysis of short, transient, non-periodic, analog signals and provide a three-dimensional description of the waveforms suitable for use in classification. Potential applications include analysis of sonar and radar signals, speech recognition and other tasks requiring pattern recognition of analog waveforms. This class of devices was developed from studies of the signal processing function of the hydromechanical action of the inner ear, which is known by the anatomical name cochlea. Design considerations, performance specifications, and circuit implementation of a 48 channel COC filter are presented in this report. The instrument operates on a bandwidth of 50 to 20,000 Hz.

Author (GRA)

N76-32451# Naval Research Lab., Washington, D.C.

K SUB a-BAND POWER HANDLING CAPABILITIES OF SELECTED RADOME MATERIALS

C. J. Stillings Mar. 1976 39 p

(NRL Proj. R01-68)

(AD-A023595; NRL-MR-3232) Avail: NTIS CSCL 09/5

Development of a periscope-mounted Ka-band satellite communication terminal for submarine use required development of a radome to enclose the antenna subsystem. Preliminary material tests at high RF power levels indicated that common radome materials would be unusable because of the high RF power densities anticipated. Tests were conducted on several materials to determine their power-handling capabilities. Results of these tests indicate that both quartz glass with polystyrene resin and quartz glass with polyimide resin would meet RF requirements. GRA

N76-32452# Office of Telecommunications, Washington, D.C. Policy Support Div.

THE WORLD'S SUBMARINE TELEPHONE CABLE SYSTEMS

H. H. Schenck Aug. 1975 280 p refs Prepared by Underseas Cable Engr., Inc.

(PB-249642/0; OTR-75-2) Avail: NTIS HC $9.25 CSCL 17B

Technical, cost, and ownership information is presented on all of the commercial underseas telephone cable systems in the world that contain at least one submerged electronic amplifier (repeater) and were in operation as of the end of 1974. Also included are: an introduction to seacable system history and technology; a description of some cables; a listing of seacable systems under construction, under international tender, or in the planning stage; lists of abbreviations and manufacturers; and a glossary of terms. GRA

N76-32453# Federal Communications Commission, Washington, D.C. Research and Standards Div.

FM BROADCAST CHANNEL FREQUENCY SPACING

Harry Fine and George L. Sharp Dec. 1975 46 p

(PB-249671/9; FCC/OCE/RS75-08) Avail: NTIS HC $4.00 CSCL 17B

The total spectrum bandwidth available for assignment to FM broadcast stations is limited and in some areas quite congested. It is therefore desirable that station assignments be made in the most efficient manner. This report studies the effect of reducing the adjacent channel frequency offset from the presently used 200 kHz to 150 kHz and to 100 kHz. The analysis shows quite conclusively that both the 100 kHz offset, with a receiver filter, and the 150 kHz offset (no filter) are more efficient in population and area coverage efficiency than the 200 kHz offset for both stereophonic and monaural operation. The 100 kHz offset, with filter, gives about twice the improvement that the 150 kHz offset offers. GRA

N76-32454# Ohio State Univ., Columbus. ElectroScience Lab.

DEVELOPMENT OF THE MULTITURN LOOP ANTENNA AT VHF FOR VEHICULAR APPLICATIONS Final Report, Jul. 1974 - Jul. 1975

P. Bohley Mar. 1976 59 p refs

(Contract DAAB07-74-C-0593; AF Proj. 6727)

(AD-A022967; ESL-3985-3; ECOM-74-0593-F) Avail: NTIS CSCL 09/5

This report describes the results of a program to develop the electrically small multiturn loop antenna for vehicular applications. The loop size used was 5 inches in diameter by 8 inches long. The operating frequency band was 30 to 80 MHz. Radiation efficiency varied from a minimum of 12% at 30 MHz to over 60% at 75 MHz. Single and multiple element array patterns are shown as a function of antenna location for a full size vehicle model. Comparisons with the AS-1729 whip are shown. The development of a remote tuning control is described which is modifiable for automatic operation.

Author (GRA)

N76-32455# Texas Instruments, Inc., Dallas.

CONTROL OF MICROCIRCUIT CONTAMINATION. A MICROSENSOR MOISTURE MEASUREMENT Final Technical Report, 5 Apr. 1974 - 22 Aug. 1975

Vincent T. Cordasco Griffiss AFB, N.Y. RADC Mar. 1976 38 p refs

(Contract F30602-74-C-0203; AF Proj. 5519)

(AD-A022974; TI-03-75-50; RADC-TR-75-317) Avail: NTIS CSCL 09/5

An anodized aluminum microsensor was developed for in-package monitoring of moisture in microcircuit package atmospheres. Sensors were characterized with respect to accuracy, reproducibility and operational limitations. Investigations included package self-generated contamination, sensor temperature cycling, stability studies, and comparison with mass spectrometry. Compatibility with semiconductor package design is discussed.

Author (GRA)

N76-32456# National Maritime Research Center, Kings Point, N.Y.

MARITIME COMMUNICATIONS FOR THE 1980'S

6 Nov. 1975 183 p refs Held at Kings Point, N. Y., 6 Nov. 1975

(PB-251088/1; MA-RD-930-76037) Avail: NTIS HC $7.50 CSCL 17B

The status and results of communication and navigation projects to improve productivity of U.S. Flag vessels are reported. These projects include: automated VHF FM radio telephone; HF digital selective calling (SELCALL); satellite communications and navigation; and fleet management enhancement by improved communications and navigation. GRA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N76-32457* National Aeronautics and Space Administration. Pasadena Office, Calif.

FURLABLE ANTENNA Patent

Morris A. Barnett, inventor (to NASA) (JPL) Issued 31 Aug. 1976 5 p Filed 24 Sep. 1975 Supersedes N75-32281 (13 - 23, p 2900) Sponsored by NASA

(NASA-Case-NPO-13553-1; US-Patent-3,978,490; US-Patent-Appl-SN-616333; US-Patent-Class-343-882; US-Patent-Class-343-915) Avail: US Patent Office CSCL 09C

An improved furlable antenna particularly suited for use in a celestial space environment is described. The antenna is characterized by an actuator comprising an elastomeric member of an annular configuration, an annular array of uniformly spaced antenna ribs rigidly affixed at the base ends to an actuator which enables it to be supported for pivotal displacement from a deployed configuration. The ribs are radially extended from the actuator to a furled configuration. The ribs are extended parallel to the axis of the actuator with flexible reflecting web affixed to the ribs, with angularly spaced bearing blocks.

Official Gazette of the U.S. Patent Office

N76-32458 Purdue Univ., Lafayette, Ind.
THE STEADY STATE ANALYSIS OF NONLINEAR SYSTEMS Ph.D. Thesis
Daniel Joseph Schaefer 1975 166 p
Avail: Univ. Microfilms Order No. 76-20292

The design and analysis of a practical electronic system often requires the examination of nonlinear circuitry. This research examines analysis techniques which are particularly useful in determining the frequency domain characteristics of the nonlinear system. Characteristics such as harmonic generation and intermodulation properties are considered in terms of the system nonlinearities. In order to apply the analysis techniques to practical problems a computer implementation, PICK is used. Given the linear characteristics of the nonlinear system together with a polynomial approximation to its nonlinear properties, the total system response to a sinusoidal input can be determined. Specific applications such as frequency translation, subharmonic generation, and jump resonance phenomenon are examined.
Dissert. Abstr.

N76-32459 Purdue Research Foundation, Lafayette, Ind.
SIMPLIFIED REPRESENTATIONS OF MULTIMACHINE POWER SYSTEMS FOR TRANSIENT AND DYNAMIC STABILITY STUDIES Ph.D. Thesis
Alexander Murdoch, III 1975 149 p
Avail: Univ. Microfilms Order No. 76-20487

Based upon the philosophy of modeling employed in the existing simulators, simplified representations of synchronous and induction machines were developed from detailed machine models. These models were designed to interface with the transmission system representation and correctly represent balanced system operation for short or long term electromechanical transients. Verification of the accuracy of these models was first done for single machine systems. The transient response to a typical fault and a comparison of stability limits demonstrates the accuracy of the simplified models when compared to the detailed benchmark model. A linearized set of equations was also studied using an eigenvalue analysis to determine the long-term dynamic characteristics of the simplified models. Similar studies were performed with a three machine system. Dissert. Abstr.

N76-32460 Mississippi Univ., University.
ANALYSIS AND SYNTHESIS OF AN IMPEDANCE-LOADED LOOP ANTENNA USING THE SINGULARITY EXPANSION METHOD Ph.D. Thesis
Ronald Fred Blackburn 1976 162 p
Avail: Univ. Microfilms Order No. 76-20518

The singularity expansion method may be used to significantly simplify the calculation and synthesis of the response of a transmitting loop antenna excited by an electromagnetic pulse. A compact representation of the loop antenna in terms of its poles and zeros is derived. The resulting time domain description of the loop response are terms involving the residues, the excitation, and the exponentially damped sinusoids whose complex frequencies are the pole frequencies. These poles or natural frequencies are the frequencies at which radiation from a scatterer or antenna can take place without an applied excitation. The possible use of the singularity expansion method to synthesize radiated time domain waveforms by uniformly loading a loop antenna is investigated. Dissert. Abstr.

N76-32461+ Radiotechniques S. A., Caen (France). Div. Industrielle et Technique.
PROTECTION OF TRANSISTORS WITH MESA STRUCTURE Final Report [PROTECTION DES TRANSISTORS DE STRUCTURE MESA]
S. D. Laou 11 Oct. 1974 71 p refs In FRENCH
(Contract DGRST-73-71-334)
Avail: NTIS HC $4.50

The problem of electrical stability of mesa structure transistors was considered using oxides deposited at low temperature as a substitute to the usual lacquer method. The method developed used silicon oxides doped with P and B. The methods used to measure the refractive index and thickness in the cases above and below 0.1 micron are detailed. The characterization of the deposited oxide is discussed with regard to dissolution velocity, maximum thickness, adhesivity on Si substrates, dielectric rigidity, dielectric constant and losses, and charge density in the oxide. The protection efficiency against Na contamination was investigated together with coating efficiency of the mesas and thermal shock resistance. A further study on low melting point glasses for filling the cavities left by the mesas is outlined. ESA

N76-32462*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
VOLTAGE STRESS EFFECTS ON MICROCIRCUIT ACCELERATED LIFE TEST FAILURE RATES Final Technical Report, Sep. 1974 - Jul. 1976
G. M. Johnson Aug. 1976 102 p refs
(Contract NAS8-31177)
(NASA-CR-149987) Avail: NTIS HC $5.50 CSCL 09C

The applicability of Arrhenius and Eyring reaction rate models for describing microcircuit aging characteristics as a function of junction temperature and applied voltage was evaluated. The results of a matrix of accelerated life tests with a single metal oxide semiconductor microcircuit operated at six different combinations of temperature and voltage were used to evaluate the models. A total of 450 devices from two different lots were tested at ambient temperatures between 200 C and 250 C and applied voltages between 5 Vdc and 15 Vdc. A statistical analysis of the surface related failure data resulted in bimodal failure distributions comprising two lognormal distributions; a 'freak' distribution observed early in time, and a 'main' distribution observed later in time. The Arrhenius model was shown to provide a good description of device aging as a function of temperature at a fixed voltage. The Eyring model also appeared to provide a reasonable description of main distribution device aging as a function of temperature and voltage. Circuit diagrams are shown. Author

N76-32463*# Martin Marietta Aerospace, Denver, Colo.
ANALYTICAL STUDY OF ELECTRICAL DISCONNECT SYSTEM FOR USE ON MANNED AND UNMANNED MISSIONS Interim Report
Arthur A. Rosener, Joseph A. Lenda, and Richard O. Trummer Aug. 1976 31 p refs
(Contract NAS8-31971)
(NASA-CR-149995; MCR-76-393) Avail: NTIS HC $4.00 CSCL 09A

The objective of this contract is to establish an optimum electrical disconnect system design(s) for use on manned and unmanned missions. The purpose of the disconnect system is to electrically mate and demate the spacecraft to subsystem module interfaces to accomplish orbital operations. The results of Task 1 and Task 2 of the effort are presented. Task 1 involves the definition of the functional, operational, and environmental requirements for the connector system to support the leading prototype candidate concepts. Task 2 involves the documentation review and survey of available existing connector designs.
Author

N76-32464*# Martin Marietta Corp., Denver, Colo.
STUDY OF SEM INDUCED CURRENT AND VOLTAGE CONTRAST MODES TO ASSESS SEMICONDUCTOR RELIABILITY Final Report
J. R. Beall Sep. 1976 123 p refs
(Contract NAS8-31567)
(NASA-CR-150005; MCR-76-464) Avail: NTIS HC $5.50 CSCL 09A

The purpose of the scanning electron microscopy study was to review the failure history of existing integrated circuit technologies to identify predominant failure mechanisms, and to evaluate the feasibility of their detection using SEM application techniques. The study investigated the effects of E-beam irradiation damage and contamination deposition rates; developed the necessary methods for applying the techniques to the detection of latent defects and weaknesses in integrated circuits; and made recommendations for applying the techniques. Author

N76-32465# Sandia Labs., Albuquerque, N.Mex.
SURFACE FLASHOVER MEASUREMENTS ON CONICAL INSULATORS SUGGESTING POSSIBLE DESIGN IMPROVEMENTS
R. A. Anderson Jan. 1976 24 p refs
(Contract AT(29-1)-789)
(SAND-75-0667) Avail: NTIS HC $4.50

Plexiglas insulators in the form of truncated cones are subjected in vacuum to high-voltage pulses having 3 ns risetime. The breakdown voltage is found to depend strongly on cone angle at angles near 0 deg. The time delay between voltage application and breakdown is measured, with nanosecond resolution, as a function of breakdown voltage and cone angle, and the effects of electrode needles and altered insulator shape near the cathode end are determined. These measurements indicate that surface flashover can proceed by two distinct mechanisms, each sensitive to details, at the appropriate insulator-electrode junction. These results suggest the performance of large-scale insulators may be improved significantly by improving the junctions. Alternative designs are proposed, including two which eliminate and make use of, leakage currents emitted from the cathode junction. Additional factors affecting breakdown are considered, including insulator suface condition, magnetic fields, and ultraviolet light. Author (ERA)

N76-32466# California Univ., Livermore. Lawrence Livermore Lab.

W2T-ARIZ/LLL1: A TIME-DOMAIN CODE FOR STUDYING ELECTROMAGNETIC SHIELDING BY WIRE GRATINGS

R. M. Bevensee 3 Nov. 1975 57 p refs

(Contract W-7405-eng-48)

(UCID-16963) Avail: NTIS HC $4.50

An extension of the code ARBANG was developed, which computes the e/sub z/(anti rho,t) field at any point in empty space for any one of three cases: (1) a single grating of ARBANG, (2) a pair of parallel gratings (with the wires parallel), and (3) one grating with a perfectly conducting plane some distance away. The theoretical basis of the code was presented and the accompanying code listing is explained. Some limitations were noted and sample computations for a particular data set were discussed. Information was given about code storage and execution time. Author (ERA)

N76-32467# California Univ., Livermore. Lawrence Livermore Lab.

APPROXIMATIONS FOR TERMS RELATED TO THE KERNEL IN THIN-WIRE INTEGRAL EQUATIONS

Al J. Poggio and R. W. Adams 19 Dec. 1975 42 p refs

(Contract W-7405-eng-48)

(UCRL-51985) Avail: NTIS HC $4.00

Difficulties can arise in the evaluation of elements in the impedance matrix associated with a moment-method solution of the thin-wire electric field integral equation. The results of a detailed study are presented, and several representations are considered and compared. From information regarding errors, regions of acceptability are obtained. The deficiencies in the thin-wire kernel are clearly illustrated and remedies are suggested. Author (ERA)

N76-32468# Helsinki Univ. of Technology, Otaniemi (Finland). Radio Lab.

A LOSSY EQUIVALENT CIRCUIT FOR INTERDIGITAL FILTERS

Kari Jokela 1975 21 p refs

(Rept-S-81; ISBN-951-750-626-0) Avail: NTIS HC $3.50

A method to derive an equivalent circuit for lossy interdigital filters is presented. The method is based on the suitable excitations of the open circuited ports of the interdigital filter. The final equivalent circuit is formed on the basis of the admittance parameters and consists of positive and negative unit elements and lambda plane inductances. The couplings over adjacent lines and the mode distortion due to the unequal attenuation constants in unsymmetrical adjacent lines were neglected. Three examples are presented in which the mode distortion approximation is tested and the results are compared to those obtained from measurements or with the orthogonal mode method. The two methods gave nearly the same results. The equivalent circuit is the most applicable to structures where the losses are relatively big and the couplings are tight thus affecting seriously the unloaded resonator Q-values. Another important application is the determination of the optimum dimensions with the aid of the impedance scaling giving the smallest losses in the passband. Author (ESA)

N76-32469# Cambridge Consultants Ltd. (England).

FAULT-TOLERANT DIGITAL HARDWARE FOR ON-BOARD SPACECRAFT APPLICATIONS, VOLUME 1. PART 1: INTRODUCTION. PART 2: CONCEPTUAL REVIEW OF FAULT-TOLERANT DESIGN. PART 3: TECHNOLOGY ASSESSMENT

Rodney Dale, ed. Jan. 1976 391 p refs 5 Vol.

(Contract ESTEC-2258/74-AK)

(ESA-CR(P)-810-Vol-1) Avail: NTIS HC $10.75

A conceptual review of fault-tolerant design techniques for space applications is presented. Three groups of design, all of which improve system reliability by the introduction of redundancy, were identified. These groups are labelled information redundancy, and modular redundancy. In addition to these techniques, the topics of fault diagnosis and reliability assessment are discussed. Existing technologies available for this problem area are assessed. Recommendations are made both on the manner in which highly reliable spaceborne equipment should be constructed and on the approach to be adopted in the reliability assessment of the hardware implementation of specific simple and fault-tolerant designs. ESA

N76-32470# Cambridge Consultants Ltd. (England).

FAULT-TOLERANT DIGITAL HARDWARE FOR ON-BOARD SPACECRAFT APPLICATIONS, VOLUME 2. PART 4: NECESSARY SUPPORTING DISCIPLINES (FAULT DIAGNOSIS, RELIABILITY ASSESSMENT AND LOGIC DESIGN). PART 5: ASSESSMENT OF FAULT-TOLERANT DESIGN TECHNIQUES

Jan. 1976 599 p refs 5 Vol.

(Contract ESTEC-2258/74-AK)

(ESA-CR(P)-810-Vol-2) Avail: NTIS HC $13.75

Topics discussed, related to fault-tolerant design, are: fault diagnosis, together with reliability modelling and assessment, and logic design principles. Problems of testing modern, complex digital systems are outlined, and the necessity for using formal analytic methods for understanding the behavior of circuits under fault conditions is demonstrated. Algorithms for circuit analysis and test sequence generation are introduced in two groups: for combinational and sequential circuits. The synthesis of testable logic is also presented, divided into the same groups. The triple modular redundancy configuration is detailed. An assessment is included of the suitability of each of the fault-tolerant techniques previously introduced for their applicability to satellite systems. ESA

N76-32471# Cambridge Consultants Ltd. (England).

FAULT-TOLERANT DIGITAL HARDWARE FOR ON-BOARD SPACECRAFT APPLICATIONS, VOLUME 3. PART 6: DESIGN EXAMPLE - A MICROPROGRAMMED CONTROLLER. PART 7: CONCLUSIONS AND RECOMMENDATIONS

Jan. 1976 151 p refs 5 Vol.

(Contract ESTEC-2258/74-AK)

(ESA-CR(P)-810-Vol-3) Avail: NTIS HC $6.75

The design exercise concerns a microprogrammed controller representing a hardware reconfiguration controller of an on-board computer. Two fault-tolerant design techniques are considered: triple modular redundancy and dual fail-safe design. The performance characteristics of the fault-tolerant designs produced by both techniques are compared. Trade-offs existing between cost characteristics of specific designs and their benefits in terms of increased system reliability and entered available lifetimes are discussed. Overall conclusions of the study are presented. ESA

N76-32472# Cambridge Consultants Ltd. (England).

FAULT-TOLERANT DIGITAL HARDWARE FOR ON-BOARD SPACECRAFT APPLICATIONS, VOLUME 4. PART 8: BIBLIOGRAPHY

Jan. 1976 182 p refs 5 Vol.

(Contract ESTEC-2258/74-AK)

(ESA-CR(P)-810-Vol-4) Avail: NTIS HC $7.50

A bibliography of fault tolerant logic design techniques is presented including a handlist of 1160 referenced works consulted and a list of 31 key works with abstracts. ESA

N76-32473# Cambridge Consultants Ltd. (England).
FAULT-TOLERANT DIGITAL HARDWARE FOR ON-BOARD SPACECRAFT APPLICATIONS Summary Report
Rodney Dale, ed. Jan. 1976 72 p 5 Vol.
(Contract ESTEC-2258/74-AK)
(ESA-CR(P)-810-Vol-5) Avail: NTIS HC $4.50

Results of a study on small-scale, fault-tolerant (highly reliable) digital hardware for use onboard spacecraft are presented. The principal fault-tolerant techniques are briefly described, together with conclusions about their value and applicability. The results of a design exercise on a sample microprogrammed controller are described and compared with those of a conventional fault-tolerant design using triple moduiar redundancy. The results of supporting studies on limitations and implications of technology, particularly large scale integrated circuits, and of reliability assessment and fault diagnosis are also presented. ESA

N76-32474# National Bureau of Standards, Washington, D.C. Electrical Technology Div.
SEMICONDUCTOR MEASUREMENT TECHNOLOGY: PERMANENT DAMAGE EFFECTS OF NUCLEAR RADIATION ON THE X-BAND PERFORMANCE OF SILICON SCHOTTKY-BARRIER MICROWAVE MIXER DIODES Final Report
James M. Kenney Apr. 1976 33 p refs Sponsored by the Defense Nuclear Agency, Washington, D. C. and Harry Diamond Labs, Adelphi, Md.
(PB-252682/0; NBS-SP-400-7; LC-76-5868) Avail: NTIS HC $4.00 CSCL 09A

The permanent damage induced by nuclear radiation in silicon Schottky-barrier X-band microwave mixer diodes was assessed by subjecting separate groups of diodes to 60Co gamma rays and fast neutrons (E> 10 keV) of progressively higher levels, reaching a total gamma dose of 1.7 x 10 to the 8th power rads (Si) and a cumulative neutron fluence of 5.5 x 10 to the 15th power/cm. Measurements were made at a local oscillator frequency of 9375 MHz to determine changes in conversion insertion loss, local oscillator return loss and SWR, IF output conductance, self-bias, and forward current at one dc bias voltage. GRA

N76-32475# Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ariz.
ANALYSIS OF INVERTED-L ANTENNAS
Charles Masen and George Lane Mar. 1976 18 p
(AD-A022554; EMEP-76-6; EMEP-296) Avail: NTIS CSCL 09/5

Frequency dependent impedance data is obtained by numerical techniques for high frequency Inverted-L Antennas (40 feet X 40 feet, 40 feet X 60 feet, 30 feet X 70 feet, and 40 feet X 80 feet). Usable frequency bands for field radio application are described. Good agreement between measured data for an Inverted-L antenna employing only a metal stake for ground reference over poor earth and calculated results is demonstrated. GRA

N76-32476# BDM Corp., Albuquerque, N.Mex.
WIRE MOMENTS PROBLEMS OF INTERMEDIATE SIZE Phase Report, 2 Jul. - 1 Oct. 1975
T. R. Ferguson Griffiss AFB, N. Y. RADC Mar. 1976 113 p refs
(Contract F30602-74-C-0182; AF Proj. 4540)
(AD-A023198; BDM/A-2-76-TR; RADC-TR-76-48) Avail: NTIS CSCL 09/3

This report discusses results obtained from a general purpose computer code for solving thin wire moments problems in which a banded matrix iterative solution technique has been substituted in the place of Gaussian elimination. Results are reported for comparison to previous reports and to solutions in the literature, including a disk, washer, sphere, hemisphere, and toroid. The effect of varied wire radius, segment lengths, and mesh size are studied. The remaining economic barrier to solving large problems is the cost of computing matrix elements. A brief study of the use of approximate matrix elements is included. Two possibilities are discussed for automating the segment numbering to minimize the bandwidth in the solution algorithm. Author (GRA)

N76-32477# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
SHAPED ELEVATION BEAM ANTENNA Final Technical Report
Robert A. Moore, Neal T. Alexander, and Henry P. Cotten Feb. 1976 121 p refs
(Contract N00014-75-C-0574; GIT Proj. A-1708)
(AD-A023225; GIT-A-1708-F) Avail: NTIS CSCL 09/5

This report contains information on the design, development, and tests of the Shaped Elevation Beam Antennas. Two identical Shaped Elevation Beam Antennas were designed, fabricated, tested and delivered to NWC. These antennas when installed in an appropriate manner will form the antenna for a height finding radar system. GRA

N76-32478# Harry Diamond Labs., Adelphi, Md.
FLUERIC LAMINAR GAIN BLOCKS AND AN OPERATIONAL AMPLIFIER SCALER
George Mon Dec. 1975 57 p refs
(DA Proj. 1T1-61102-A-33B; HDL Proj. 302531)
(AD-A023077; HDL-TR-1730) Avail: NTIS CSCL 09/5

This report discusses the analytical and experimental design of laminar proportional gain blocks and an operational amplifier scaler. In this study, eight different laminar proportional amplifier (LPA) configurations were tested and evaluated for use in the design of gain blocks and an operational-amplifier scaler. The input and output characteristics, the Reynolds number and bias control pressure effects on the gain, and the proper operating Reynolds number range of these LPA's were measured. An op-amp scaler has been designed and tested using a three-stage gain block with all stages operating at the same supply pressure. Test results indicate that this scaler with a forward loop gain of about 60 has an accuracy of 90 percent for the Rf/Ri ratio between 0.521 and 3.59, which agrees well with the analytical predictions. GRA

N76-32479# Naval Research Lab., Washington, D.C.
LONG-HOLD-TIME LIQUID-HELIUM DEWAR FOR COOLING OF A SQUID ELF ANTENNA Final Report
Robert J. Dinger, John R. Davis, and Martin Nisenoff Mar. 1976 13 p refs
(NRL Proj. R07-34; XF21222035)
(AD-A023467; NRL-MR-3256) Avail: NTIS CSCL 09/5

An extremely-low-frequency (ELF) receiving antenna that uses superconducting quantum interference devices (SQUIDs) as the sensing elements must be cooled to cryogenic temperatures for proper operation. The simplest and most reliable cooling technique consists of mounting the SQUID sensors in a dewar whose liquid-helium hold time is long enough to exceed the duration of a typical submarine deployment. To verify that such an approach is feasible, a fiberglass dewar capable of fitting into the operational AN/BRA-8 towed communication buoy was procured and tested. The dewar is constructed of fiberglass and uses vapor-cooled shields to achieve a low rate of liquid-helium boiloff. The dewar was designed to hold liquid helium for at least 90 days; an actual hold time of 102 days was measured. No major problems are anticipated in adopting the basic design of the tested dewar to a version suitable for operational use. GRA

N76-32480# Northrop Research and Technology Center, Hawthorne, Calif.
LSI DIGITAL FREQUENCY SYNTHESIZER Final Report, 14 Mar. - 16 Jun. 1975
R. A. Allen and M. G. Krebs Ft. Monmouth, N. J. ECOM Oct. 1975 76 p
(Contract DAAB07-74-C-0212; DA Proj. 1S7-672703-DH-9)
(AD-A022910; NRTC-74-73R; ECOM-74-0212-F) Avail: NTIS CSCL 09/5

Results are presented on the development of an integrated injection logic (I2L) digital frequency synthesizer (DFS). The prototype DFS was designed to operate at a 4.8 MHz clock rate outputting eight fixed frequencies from dc to 2.4 MHz. The processing, testing and evaluation of I2L logic test cells is reported. The minimum stage delay achieved for a test I2L inverter was 8.7 ns. The design rules applicable to standard cell large scale I2L are discussed. The prototype DFS design, layout and testing is presented. Approximately 640 basic I2L inverters were required to implement the prototype DFS. Average power dissipation at

the 4.8 MHz clock rate is estimated to be 20 micro W per inverter. The feasibility of future expansion of the DFS to provide 640 frequencies at 4.8 MHz and 128 frequencies at 12.5 MHz clock rate is discussed. Author (GRA)

N76-32481# Ohio State Univ., Columbus. ElectroScience Lab.
APPLICATION OF THE HYBRID TECHNIQUE TO TIME DOMAIN PROBLEMS M.S. Thesis
G. K. Chan and G. A. Thiele Sep. 1975 60 p refs
(Contract N00014-75-C-0313)
(AD-A023120; ESL-4091-1) Avail: NTIS CSCL 09/5

A hybrid technique for combining the Method of Moments with the Geometrical Theory of Diffraction in the frequency domain is described. Typical results for a monopole near a perfectly conducting wedge and for a monopole at the center of a circular disc are presented. It is shown that, since the Method of Moments characterizes only a portion of the problem, it is computationally economical to generate sufficient frequency domain data to obtain time domain solutions via the Fast Fourier Transform (FFT). To illustrate the method, the problem of a monopole at the center of a disc is considered for several cases, including a step input, a Gaussian pulse input and a Gaussian pulse plane wave incident upon the monopole disc structure from various aspect angles. GRA

N76-32482# Ohio State Univ., Columbus.
ANALYSES OF VARIOUS PERIODIC SLOT ARRAY GEOMETRICS USING MODAL MATCHING Ph.D. Thesis. Interim Report, 1 Jan. - 31 Jul. 1975
R. J. Luebbers Wright-Patterson AFB, Ohio AFAL Feb. 1976 262 p refs
(Contract F33615-73-C-1173; AF Proj. 7633)
(AD-A023257; ESL-3622-4; AFAL-TR-75-119) Avail: NTIS CSCL 09/5

A ground plane pierced periodically with resonant slots can, with proper design, transmit an incident plane wave with no loss at its resonant frequency but with loss at all other frequencies. Such a structure is known variously as a periodic slot array or as a resonant window. These structures have application as radomes and in dual frequency antenna feeds. GRA

N76-32483# RCA Labs., Princeton, N.J.
MICROWAVE SHIFT REGISTER Annual Report, 7 Oct. 1974 - 14 Dec. 1975
L. C. Upadhyayula, R. E. Smith, and J. F. Wilhelm 12 Feb. 1976 65 p refs
(Contract N00014-75-C-0100; NR Proj. 251-023; RF54581001)
(AD-A022580; PRRL-76-CR-10) Avail: NTIS CSCL 09/5

The objectives of the research program are: (1) to develop monostable planar GaAs transferred electron logic devices (TELDs), (2) to design, fabricate, and evaluate a 4-bit TELD shift register operating at multigigabit rates, and (3) to begin the investigation of bistable (blocked domain) TELDs. Major accomplishments to date are: (1) development of new design guidelines, based on which were developed TELDs capable of processing pulses as narrow as 80 ps with delay-dissipation product of 10 pJ, (2) discovery of a quasi-enhancement mode of operation which has potential for greatly reducing power consumption and increasing stability against power supply fluctuations, and (3) fabrication of critical building blocks (Memory, AND, and DELAY) of a shift-register. The efforts in all these areas are described in detail. GRA

N76-32484# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
ANALYSIS OF NONLINEARLY LOADED N-PORT ANTENNA STRUCTURES
Tapan K. Sarkar, Donald D. Weiner, and Roger F. Harrington Apr. 1976 41 p refs
(Contract N00014-76-C-0225)
(AD-A023190; TR-76-4; TR-2) Avail: NTIS CSCL 09/5

Volterra series analysis is applied to the analysis of nonlinearly loaded antennas over an imperfect ground plane. The nonlinear loads may be applied simultaneously at N different ports. The nature of the imperfect ground can be taken into account either exactly by the Sommerfeld formulation or approximately by the reflection coefficient method. The electromagnetic field problem is first reduced to a network problem by application of the method of moments. The nonlinear network problem is then solved using the Volterra technique. A procedure for obtaining a time domain solution from the frequency domain solution without using fast Fourier transform techniques is demonstrated. Author (GRA)

N76-32485# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
ONR-CORNELL CONFERENCE ON ACTIVE SEMICONDUCTOR DEVICES FOR MICROWAVES AND INTEGRATED OPTICS Final Report
Joseph L. Rosson 3 Mar. 1976 72 p refs Conf. held at Ithaca, N. Y., 19-21 Aug. 1975
(Grant N00014-75-G-0007; NR Proj. 372-056)
(AD-A022039) Avail: NTIS CSCL 09/13

The meetings were intended to examine a particular segment of electrical technology in some depth. The choice of a topic was dictated by its current interest and importance and the meetings were designed to afford a comprehensive view of a particular field, see what its current status is, and determine where it is heading in the future. In line with this philosphy, the program combined tutorial presentations with new contributions so as to give an integrated picture of the state of the art at a time of the meeting. Furthermore, the meetings were planned to link basic phenomenological discussions with applications of fundamental materials to active semiconductor devices for microwaves and integrated optics. GRA

N76-32376 Los Alamos Scientific Lab., N.Mex.
VAPOR FLOW CONSIDERATIONS IN CONVENTIONAL AND GRAVITY-ASSIST HEAT PIPES
J. E. Kemme *In* ESA Heat Pipes 1976 p 11-22 refs Sponsored by Energy Res. and Develop. Admin. (For availability see N76-32374 23-31)

N76-32377 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
INVESTIGATION OF PERFORMANCE OF GRAVITY ASSISTED COPPER-WATER HEAT PIPES
A. Abhat and H. Nguyenchi *In* ESA Heat Pipes 1976 p 23-36 refs (For availability see N76-32374 23-31)

N76-32389* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HEAT PIPES FOR SPACECRAFT TEMPERATURE CONTROL: AN ASSESSMENT OF THE STATE-OF-THE-ART
M. Groll and J. P. Kirkpatrick *In* ESA Heat Pipes 1976 p 167-181 refs (For availability see N76-32374 23-31)
CSCL 20D

N76-32390* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF AXIAL GROOVES TO CRYOGENIC VARIABLE CONDUCTANCE HEAT PIPE TECHNOLOGY
Patrick J. Brennan (B and K Eng., Inc.) and Manfred Groll *In* ESA Heat Pipes 1976 p 183-195 refs (For availability see N76-32374 23-31)
CSCL 20D

N76-32392 Akademiya Nauk BSSR, Minsk.
HEAT AND MASS TRANSFER IN CRYOGENIC GAS-LOADED HEAT PIPES
L. L. Vasiliev, S. V. Konev, A. M. Marchenko, A. D. Shnyryov, I. S. Desyukevich, and V. V. Gill *In* ESA Heat Pipes 1976 p 207-213 refs (For availability see N76-32374 23-31)

N76-32426 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
SOUNDING ROCKET HEAT PIPE AND PCM THERMAL CAPACITOR EXPERIMENTS
H. Koch, J. Lorschiedter, R. Strittmatter, and P. H. Pawloski (DFVLR-BPT, Cologne) *In* ESA Heat Pipes 1976 p 607-620 (For availability see N76-32374 23-31)

N76-32428* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LONG TERM PERFORMANCE OF THE ADVANCED

THERMAL CONTROL FLIGHT EXPERIMENT
Patrick J. Brennan (B and K Eng., Inc.) and Jac P. Kirkpatrick *In* ESA Heat Pipes 1976 p 629-643 refs (For availability see N76-32374 23-31)
CSCL 20D

N76-32432 B & K Engineering, Inc., Towson, Md.
DEFINITION OF A CRYOGENIC HEAT PIPE EXPERIMENT
Edward J. Kroliczek *In* ESA Heat Pipes 1976 p 673-682 (For availability see N76-32374 23-31)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N76-32486 Kentucky Univ., Lexington.
ANALYSIS OF THREE-DIMENSIONAL FLOW IN CONFINED AQUIFERS BY THE FINITE ELEMENT METHOD Ph.D. Thesis
Shen-Jyh Wu 1976 342 p
Avail: Univ. Microfilms Order No. 76-20169

A new three dimensional finite element method is presented for analyzing the unsteady piezometric head and drawdown in confined aquifers. In the analysis, the parabolic governing differential equation based on Darcy's law is converted to a set of simultaneous equations by the variational principles. The aquifer considered can be regular or irregular, isotropic or anisotropic, homogeneous or nonhomogeneous. The wells in the aquifer are infinitesimal in radius with constant or variable pumping rates. A computer program based on the new finite element method is developed by using a high speed computer. Two types of finite elements are used to simulate the aquifers. To use the computer program requires only a minimum amount of input data for specifying the types of finite elements and option to be used and the shape and characteristics of the aquifer.
Dissert. Abstr.

N76-32487 Dartmouth Coll., Hanover, N.H.
AXISYMMETRIC ACCRETION FLOWS IN COMPACT X-RAY SOURCES Ph.D. Thesis
Richard Leo Thomas Wolfson 1976 204 p
Avail: Univ. Microfilms Order No. 76-19963

The axisymmetric hypersonic flow of gas past a gravitating point mass is studied with both one and two dimensional methods. The results are applied in a discussion of wind driven compact X-ray sources. Two dimensional analysis confirms the tendency to form a high density region on the accretion axis, even when nonlinear gasdynamic effects are included. Shock detachment occurs when the specific heat ratio is equal to 5/3, but that below this value conical shocks attached to the point mass are possible. Finally, the two dimensional analysis admits a brems-strahlung loss term, and shows the shock cone angle decreasing with increasing losses. The one dimensional analysis introduces an energy equation into the theory of Bondi and Hoyle, and the resulting sonic structure of the flow is determined. Finally, the theoretical results are applied to a model for the binary X-ray source 3U 1700-37. Dissert. Abstr.

N76-32488 Purdue Univ., Lafayette, Ind.
THE APPLICATION OF A LASER DOPPLER VELOCIMETER (LDV) IN INTERPRETING TURBULENT STRUCTURE Ph.D. Thesis
Ronald Dumont Flack, Jr. 1975 170 p
Avail: Univ. Microfilms Order No. 76-20272

A mathematical model based on a combination of two-dimensional eddies of various sizes and strengths was developed as a basis for the analysis of laser Doppler velocimeter performance in turbulent flows. Parameters for the model were determined from hot wire anemometer data for subsonic jets and individual realization LDV measurements in the near wake of an axisymmetric supersonic jet. Mean velocity, turbulence intensity, and other flow parameters can be determined from the model. Ten fundamental types of signal bias which affect the measured mean velocity and turbulence intensity were identified. The probable magnitudes of these biases were related to: (1) the LDV parameters (comparator tolerance setting and, if applicable, clock frequency; LDV configuration - probe volume size, angle or orientation to the mean flow direction, fringe spacing, number of fringes used, and frequency shifting; and filter cut-off frequencies); (2) the mean velocity, turbulence intensity, skewness, kurtosis and turbulent macroscale of the flow; and (3) other features of the flow including particle seeding concentration and distribution. Dissert. Abstr.

N76-32489 Carnegie-Mellon Univ., Pittsburgh, Pa.
COMPUTATIONAL AND EXPERIMENTAL STUDIES OF TWO-DIMENSIONAL NONLINEAR PERISTALTIC PUMPING Ph.D. Thesis
Thomas Dudley Brown 1976 179 p
Avail: Univ. Microfilms Order No. 76-19322

Flow processes in nonlinear peristaltic pumping were studied both computationally and experimentally, where the system is characterized by the propagation of highly curvilinear wall-waves at finite Reynolds numbers. Finite-difference forms of the full Navier-Stokes equations are solved in a boundary-fitted orthogonal curvilinear coordinate mesh, using an implicit iterative procedure. The steady-state numerical solution is confirmed by flow visualizations from a model study conducted in a glycerine-filled towing tank. The effects of Reynolds numbers between 2.36 and 251 were examined, as well as the limiting case of potential flow. Other dynamic variables studied numerically include the net pressure drop per wavelength and wall extensibility versus inextensibility. The experimental apparatus is further used to conduct a simplified model study of the transport of large solid particles by peristalsis. Details of the experimentally observed solid particle trajectories correlate with those of fluid elements obtained by numerical integration of the computational velocity field. Dissert. Abstr.

N76-32490 Cornell Univ., Ithaca, N.Y.
DYNAMICS OF TRANSIENT WIND-DRIVEN CIRCULATION IN A STABLY STRATIFIED BASIN BY THE FINITE ELEMENT ANALYSIS Ph.D. Thesis
Der-Liang Young 1976 297 p
Avail: Univ. Microfilms Order No. 76-21151

Methods for the prediction of stratified flow and temperature distribution in lakes are formulated in the finite element method. Numerical solutions are presented to demonstrate that the results are qualitatively similar to those observed in the analogous field situation of wind-driven, stratified lakes. A transient, two-dimensional model with idealized topography (i.e., cross section of a rectangular lake) is examined. The set of four relevant partial differential equations is transformed to a pair of nonlinear differential equations in the stream-function and density. Integral conditions corresponding to the solution of these equations are set up through the Galerkin weighted residual concept, and finite element representations of the integrals are constructed. A triangular plate bending element with nine degrees of freedom is employed for the computation. Finite differences are used in time. The system of nonlinear, algebraic equations is solved by a quasi-linearization technique. Dissert. Abstr.

N76-32491 California Inst. of Tech., Pasadena.
HEAT TRANSFER IN AN ANNULAR GAP Ph.D. Thesis
Samuel Robert Maurice Gardiner 1976 166 p
Avail: Univ. Microfilms Order No. 76-20428

Heat transfer coefficients were obtained for smooth and slotted rotors for the range of rotational Taylor numbers of 500 to 5 million, axial flow Reynolds numbers of 0 to 7,000, and three Prandtl numbers. Some axial friction factors are also presented. The superposition of axial flow in general increases the heat transfer coefficient. It does, however, delay the onset of Taylor vortices and may therefore have an adverse effect on heat transfer at low Taylor numbers. The slotted rotor for the most part led to higher heat transfer coefficients. In the region in which comparison could be made with data in the literature, good agreement was found to exist. Dissert. Abstr.

N76-32492 Purdue Univ., Lafayette, Ind.
AN UPPER BOUND ON TURBULENT HEAT TRANSPORT ACROSS A LAYER OF ELECTRICALLY CONDUCTING BOUSSINESQ FLUID UNDER A MAGNETIC CONSTRAINT Ph.D. Thesis
Stephen Tedford Montgomery 1975 103 p
Avail: Univ. Microfilms Order No. 76-20483

The problem of finding an upper bound on the heat transport across a layer of electrically conducting Boussinesq fluid in the presence of a uniform magnetic field is considered. The analysis is restricted to statistically steady turbulent convection and the problem is studied using the variational theory of turbulence. The variational principle is formulated for a functional that includes the influence of the magnetic field. The resulting Euler-Lagrange equations are studied using a boundary layer approximation and the assumption of a single horizontal wave number. The results indicate that two regimes of turbulent hydromagnetic convection exist. The first occurs when the turbulence is strong or the size of the magnetic field is small. The maximum heat transport is only slightly reduced by the presence of the magnetic field and, as the intensity of the turbulence increases, the heat transport approaches the value for the nonmagnetic case. The other regime occurs for weak turbulence or a strong magnetic field. The heat transport is then inversely proportional to the size of the magnetic field, and it is found that a strong enough magnetic field completely suppresses the convection. Dissert. Abstr.

N76-32493 City Univ. of New York.
THE STABILITY OF PLANE COUETTE FLOW Ph.D. Thesis
Terence Patrick Coffee 1976 95 p
Avail: Univ. Microfilms Order No. 76-21162

The effect of small disturbances on laminar plane Couette flow is studied. If the disturbances are infinitesimal, the effects are described by the Orr-Sommerfeld equation. Chebyshev polynomials are used to reduce the system to linear algebra. The resulting eigenvalue problem is solved using the generalized Rayleigh quotient, which involves substantially less computer time than previous methods. Accurate eigenvalues are then computed for higher values of the parameters than has been done previously. These values further confirm the belief that Couette flow is stable under infinitesimal disturbances. Using the linear results as a starting point, the effect of finite disturbances is studied. A system of equations is derived from the Navier-Stokes equations, taking into account non-linear terms. In this case, the flow becomes turbulent for certain values of the parameters. Dissert. Abstr.

N76-32494 Rochester Univ., N.Y.
GAS ABSORPTION BEHIND A REFLECTING SHOCKWAVE Ph.D. Thesis
Nicholas K. Kanellopoulos 1976 138 p
Avail: Univ. Microfilms Order No. 76-14765

Carbon dioxide absorption by ethanolamines was studied at different gas-liquid contact times. Equilibrium data of long contact times (up to 70 hours) were analyzed for both anhydrous and water containing systems. A satisfactory fitting of the experimental data was obtained, based on a reaction mechanism postulated for the CO2 reactions with diethanolamine and water. Values of the equilibrium constants at different temperatures were obtained. CO2 was obtained and reacted with diethanolamine to produce ions, which cause a rapid increase of the conductivity of the liquid. The gas pressure behind the reflecting shockwave remained constant only for a fraction of a millisecond, due to oscillations caused by the compression and the rarefaction waves. A lateral shearing interferometric technique was used to detect the liquid phase processes. This optical method failed to give results for the anhydrous solutions, but it can be used with aqueous ethanolamine solutions. Dissert. Abstr.

N76-32495 Purdue Univ., Lafayette, Ind.
A STUDY OF THE FLOW INDUCED BY A PARTIALLY SUBMERGED ROTATING DISK Ph.D. Thesis
James Peter Macey 1975 202 p
Avail: Univ. Microfilms Order No. 76-20475

The hydrogen bubble technique was used for the determination of the velocity components and the pearl essence flow visualization material for the study of a wave flow phenomenon. The hydrogen bubble measurements are among the first in this type of flow field and are in general agreement with the previous analytical solutions. The results could not be quantified due to the basic difficulties encountered in the application of this method of measurement. Three regimes of enclosed disk flow have been established with the transition to the wave flow defined in terms of a critical disk radius to spacing ratio and the disk radius Reynolds number. While the wave number, defined as the number of vortices in the wave pattern, could not be determined uniquely, a correlation was obtained between the number of waves and the pattern speed ratio. Dissert. Abstr.

N76-32496 Akron Univ., Ohio.
TRANSIENT HEAT TRANSFER FOR LAMINAR AND TURBULENT BOUNDARY LAYER FLOWS WITH EFFECTS OF WALL CAPACITANCE AND RESISTANCE Ph.D. Thesis
Roger Chang-Chen Wang 1976 161 p
Avail: Univ. Microfilms Order No. 76-19318

Transient forced convective heat transfer from both laminar and turbulent boundary layer flows over a flat plate with appreciable thermal capacity and resistance is studied analytically. For the case of the conjugated fluid-solid system associated with a laminar flow, the integral method is utilized to reduce the systems of nonlinear differential equations to a single integro-differential equation in terms of the interfacial temperature which is then solved with the aid of a finite difference technique. For the case of fully turbulent flow, the principle of surface renewal is employed together with the integral method. Furthermore, predictions are given for the transfer coefficient for turbulent flow over a flat plate of finite length which accounts for the laminar leading edge effect. Numerical results for the fluid-solid interfacial temperature, heat transfer coefficient and temperature distributions within the fluid and the solid are presented. Dissert. Abstr.

N76-32497 Washington Univ., Seattle.
THE HEAT CAPACITY OF MULTILAYERS OF He-3 ADSORBED ON GRAPHITE Ph.D. Thesis
Steven Ward VanSciver 1976 138 p
Avail: Univ. Microfilms Order No. 76-20735

The heat capacity of He-3 adsorbed on graphite was measured from monolayer completion, n = 0.108A to the minus 2, to the multilayer region, n = 0.275A to the minus 2, over a temperature range of 0.04K to 4.2K. Sixteen different coverages were investigated. Below 0.186A to the minus 2, the behavior of the additional film is analogous to the low density submonolayer, having properties attributable to a 2D interacting quantum gas. No substrate ordered phase was observed allowing the 2D vapor to be investigated to higher densities than on the first layer. The shoulder in the signal near 0.1K in this data appears nearly unchanged from the submonolayer. For the higher densities, the peak shifts to lower temperature and becomes quite sharp. Desorption effects above 1.5K are understood in terms of reduced substrate binding. Adsorption energies determined from vapor pressure and heat capacity data agree closely with calculated values. Dissert. Abstr.

N76-32498 Catholic Univ. of America, Washington, D.C.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF A VORTEX SENSOR THAT COMPARES FLUID DENSITIES Ph.D. Thesis
Arthur Joseph Ostdiek 1976 208 p
Avail: Univ. Microfilms Order No. 76-19371

The vortex concentration sensor, a fluidic device that compares the density of two fluid streams is analyzed. Fluid is supplied to an axisymmetric cavity by a manifold system that is divided into two equal segments, each connected to a separate fluid source. The radial vector locating the dividing partition of the dual manifold is held parallel to the gravity vector. The resulting body force on two fluids of unequal density causes a weak, axisymmetric vortex to form. The swirl angle is measured by an angle of attack detector near the drain at the axis of the cavity. The differential output pressure signal is a linear function of the density difference. The diffusion equation is solved as a function of all three spatial variables and time. A body force term is calculated, and the axisymmetric tangential momentum equation is solved. The results are used to predict the static and dynamic characteristics of the sensor. Dissert. Abstr.

N76-32499+ Societe Nationale Industrielle Aerospatiale, Suresnes (France).
INVERSION CALCULATION METHOD FOR A TWO DIMENSIONAL COMPRESSIBLE FLOW [METHODE DE CALCUL INVERSE EN BIDIMENSIONNEL COMPRESSIBLE]
Y. Morchoisme Paris Assoc. Aeron. et Astronautique de France Nov. 1975 23 p refs In FRENCH Presented at the 12th Ecole Natl. Sup. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-4; ISBN-2-7170-0382-7) Avail: NTIS HC $3.50; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

A technique using the singularity method was developed. Numerical results for two profiles (VI and S) are presented. The method developed is asymptotically exact only for subcritical flows; the convergence for supercritical flows may be long or even impossible. ESA

N76-32500# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
THE EVOLUTION OF A SHOCK WAVE GENERATED BY A POINT EXPLOSION IN A COMBUSTIBLE MEDIUM Ph.D. Thesis
Alexander Burcat May 1976 35 p refs
(TAE-282) Avail: NTIS HC $4.00

The evolution of a peak energy release behind a shock front travelling in a combustible medium and generated by a strong point explosion was investigated. The problem was explored using self-similar solutions which exposed a group of heat release functions whose different combinations were studied. Author

N76-32501# Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
HEAT TRANSFER TO PSEUDOPLASTIC FLUIDS IN AN AGITATED VESSEL
S. Suryanarayanan, B. A. Mujawar, and M. Raja Rao 1976 28 p refs
Avail: NTIS HC $4.00

Heat transfer coefficients of water and dilute aqueous polymer solutions of sodium corboxy methyl cellulose and sodium alginate were studied in a turbine agitated vessel for standard and nonstandard vessel configurations. Parameters taken into consideration include: agitator diameter, depth of agitation, helix diameter, and coiled tube outside diameter. The jacket and coil side heat transfer results are correlated. Author

N76-32502# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
RAPID DISTORTION OF AXISYMMETRIC TURBULENCE
K. R. Sreenivasan and R. Narasimha Apr. 1976 45 p refs
(Rept-76-FM-3) Avail: NTIS HC $4.00

An isotropic theory was generalized to estimate the effect of sudden but arbitrary three-dimensional distortion on homogeneous, initially axisymmetric turbulence. The energy changes due to distortion are expressed in terms of the Fourier coefficients of an expansion in zonal harmonics of the two independent scalar functions that describe the axisymmetric spectral tensor. However, for two forms of the spectral tensor, in which the angular distribution is specified but not the wave-number dependence of the spectrum, the energy ratios were determined in closed form. The deviation of the ratio from its isotropic value is a product of a factor containing R, the initial value of the ratio of the longitudinal to the transverse energy component, and another factor depending only on the geometry of the distortion. Author

N76-32503*# P-V-T, Inc., Houston, Tex.
FLUID PROPERTY MEASUREMENTS STUDY
Will E. Devaney 31 Aug. 1976 98 p refs
(Contract NAS9-14685)
(NASA-CR-150985; D-75175) Avail: NTIS HC $5.00 CSCL 20D

Fluid properties of refrigerant-21 were investigated at temperatures from the freezing point to 423 Kelvin and at pressures to 1.38 x 10 to the 8th power N/sq m (20,000 psia). The fluid properties included were: density, vapor pressure, viscosity, specific heat, thermal conductivity, thermal expansion coefficient, freezing point and bulk modulus. Tables of smooth values are reported. Author

N76-32504# Science Applications, Inc., McLean, Va.
LAGRANGIAN SIMULATIONS OF THE KELVIN-HELMHOLTZ INSTABILITY
Martin J. Fritts Sep. 1976 61 p refs
(SAI-76-632-WA) Avail: NTIS HC $4.50

A Lagrangian general-connectivity grid has been used to study the evolution of shear layers in an inviscid incompressible fluid. The linear stages of growth for the Kelvin-Helmholtz instability are compared with theoretical results for homogeneous and stratified layers. The growth of instabilities is followed through the formation of billows and beyond, into their coalescence to form a turbulent layer. The use of a Lagrangian formulation permits the natural elaboration of the history of a nearby free surface, as well as the details of the flow of particular regions of the fluid. Author

N76-32505*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW-PERIGEE AERODYNAMIC HEATING DURING ORBITAL FLIGHT OF AN ATMOSPHERE EXPLORER
Paul S. Caruso, Jr. and Charles R. Naegeli Sep. 1976 70 p refs
(NASA-TN-D-8308; G-76102) Avail: NTIS HC $4.50 CSCL 20M

An extensive, low-perigee orbital aerodynamic heating study was undertaken in support of the Atmosphere Explorer-C Temperature Alarm. State of the art of low-density, high-speed flows, some models of the earth's atmosphere, external flow-field definition, thermodynamic and transport properties of atmospheric gases, the accommodation coefficient orbital thermal environment, and correlation of theory and measurements are discussed. Aerodynamic heating rates are determined for eight selected orbits by means of a reduced, analytical model verified by both ground test and flight data. These heating rates are compared with classical free-molecule and first-order collision regime values. Author

N76-32506# Los Alamos Scientific Lab., N.Mex.
VAPOR FLOW CONSIDERATIONS IN CONVENTIONAL AND GRAVITY-ASSIST HEAT PIPES
J. E. Kemme 1976 14 p refs Presented at the 2d Intern. Conf. on Heat Transfer, Bologna, Italy, 31 Mar. - 2 Apr. 1976
(Contract W-7405-eng-36)
(LA-UR-75-2308; Conf-760313-2) Avail: NTIS HC $3.50

Terrestrial applications for heat pipes have grown rapidly in recent years, particularly in areas involving permafrost stabilization and energy conservation. Ordinarily, these applications do not require heat pipes that are conventional in the sense that circulation of working fluid is maintained exclusively by capillary forces. Instead, they usually permit heat-pipe operation with the condenser elevated so that condensate is returned to the evaporator with gravity assistance. When operated in this manner, relatively high rates of heat transfer have been achieved even with heat pipes containing simple and inexpensive wicks and working fluids having low surface tensions. When the performance of a heat pipe is improved substantially by gravity assistance or by employing some type of composite wick, heat transfer is often limited primarily by vapor flow effects as opposed to liquid pressure losses. Five separate effects and their associated limitations were encountered in experiments with liquid-metal working fluids. All are identified. ERA

N76-32507# Sandia Labs., Albuquerque, N.Mex.
THERMODYNAMICS AND THE PROPAGATION OF SHEAR-ACCELERATION WAVES IN INCOMPRESSIBLE VISCOELASTIC FLUIDS
Jace W. Nunziato and E. K. Walsh 1975 19 p refs Presented at the 8th Southeastern Conf. on Theoretical and Applied Mechanics, Blacksburg, Va., Apr. 1976 Sponsored by ERDA
(SAND-75-6100; Conf-760404-1) Avail: NTIS HC $3.50

A formulation for the constitutive theory of incompressible viscoelastic fluids is described which is an alternative to the usual formulation in terms of a relative strain history. The formulation discussed considerably simplifies matters and yet retains the present configuration as the reference configuration; in this way the formulation is suitable for flow problems. In particular, the general thermodynamic theory of heat-conducting fluids is considered, and it is shown that the constitutive equations

can be written in terms of summed histories. The use of these histories results in simple differential forms; the consequences of the Second Law can therefore be derived in a more direct and concise fashion. The general propagation condition governing shear-acceleration waves and some related results are also derived. ERA

N76-32508# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
THE EFFECT OF GEOMETRIC CHANGES DUE TO CONTAMINATION ON FLUID AMPLIFIER PERFORMANCE Final Report
Hal L. Moses and Erol Sancaktar Nov. 1975 87 p refs
(Contract DAAG39-74-C-0192; DA Proj. 1T1-61102-A-33B)
(AD-A022579; HDL-CR-75-192-1) Avail: NTIS CSCL 13/7

An investigation of the effect of geometric changes due to a buildup of contamination in the flow passages of a laminar proportional amplifier is described. The geometric changes were accomplished by adding a known amount of material (artificial buildup) at various locations and by introducing a mixture of oil vapor and dust into the air supply. The results include photographs of the buildup, measured gain curves at various flow conditions, impedance measurements, and some comparisons of the experimental data with an analytical model. GRA

N76-32509# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
DEDUCTION OF THE TURBULENT PRANDTL NUMBER IN THE WALL REGION FROM WALL MEASUREMENTS IN THE THERMAL ENTRY Interim Report
M. F. Taylor, P. E. Pickett, and D. M. McEligot 1 Jul. 1975 28 p refs
(Contract N00014-75-C-0694; NR Proj. 097-395)
(AD-A023625; Rept-1248-2) Avail: NTIS CSCL 20/13

Recent numerical analytic methods for the thermal entry region are synthesized with measurements of the local Nusselt number in a circular tube to provide a diagnostic technique to deduce the turbulent Prandtl number in the wall region from measurements in the immediate thermal entry. The technique provides a means to obtain information on the turbulent Prandtl number profile even when other considerations, such as cost or buoyancy effects, require that test section dimensions be too small for direct measurements with probes. GRA

N76-32510# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
ON THE INTERACTION BETWEEN A STRUT AND THE FREE SURFACE Final Report, 1 Oct. 1972 - 31 Jul. 1975
T. Frances Ogilvie Aug. 1975 39 p refs
(Contract N00014-67-A-0181-0053; SR0230101)
(AD-A022959; Rept-175) Avail: NTIS CSCL 13/10

A procedure is proposed for solving problems involving the flow around surface-piercing struts. There are three steps: (1) an infinite-fluid problem must be solved, in which the flow is antisymmetrical with respect to the plane of the undisturbed free surface; (2) from that solution, there is effectively a distribution of normal velocity imposed on the plane of antisymmetry; the resulting wavelike disturbance can be found by a procedure which is effectively a slender-body analysis; (3) the wavelike disturbance produces a disturbance on the body (strut), which must be canceled by yet another wavelike motion, which can also be found locally from a slender-body analysis. In order to justify the second and third steps, some difficulties and advantages associated with slender-ship theory are examined. It is shown how the usual axial source distribution of slender-ship theory can be modified systematically so that the slender-ship wave resistance becomes identical to the classical result of Michell for a thin ship. The slender-ship procedure has the further advantage that it is not limited to thin bodies, in particular, the body boundary condition should logically be satisfied on the exact location of the body surface, not on the centerplane. Author (GRA)

N76-32511# Franklin Inst., Philadelphia, Pa.
DEMONSTRATION OF ADIABATIC COOLING TO IMPROVE THE PERFORMANCE OF AIR-COOLED HEAT EXCHANGERS
Alan M. Rubin Oct. 1975 37 p refs
(Contract E(11-1)-2673)
(COO-2673-1) Avail: NTIS HC $4.00

A demonstration of improved heat exchanger performance by adiabatically cooling the inlet air to an air-cooled heat exchanger was performed on a condenser that had a design heat rejection rate of 58 million Btu/hr. Pneumatic nozzles were used to inject atomized water into the inlet air stream. Mean droplet diameters ranged from 16 to 28 microns for all of the tests. Results of these experiments comparing conventional and adiabatic cooling show that adiabatic cooling does improve heat transfer performance in accordance with expectations. The operation of the system was simple and reliable. Visual observations of the heat exchanger showed that finned surfaces remained dry even when enough water was added to saturate the inlet air. With the use of efficient atomizers, adiabatic cooling improves efficiency at a steam-electric power plant without increasing dry cooling tower size, and thereby avoids the need to reduce plant output during hot weather. ERA

N76-32512# Bell Aerospace Co., Buffalo, N.Y.
SOME ASPECTS OF GAS-PARTICLES JETS IN A CROSS FLOW Interim Report
George Rudinger 1975 9 p refs Presented at Symp. on Nonequilibrium Two-Phase Flow, ASME Winter-Ann. Meeting, Houston, Tex., 30 Nov. - 5 Dec. 1975
(Contracts F44620-70-C-0116; N00014-67-A-0226-0005)
(AD-A023052; AFOSR-76-0250TR) Avail: NTIS CSCL 20/4

The concept of an equivalent gas jet is developed for the case that the particles are small enough relative to the size of the jet to be able to follow substantially the flow of the carrier gas. This concept is shown to be applicable if the injection velocity of the particles is greater than about 40% of the jet velocity. Experiments with 33-micrometers glass beads carried by a nitrogen jet of about 3 mm diameter are described. Velocities of the carrier gas and of the cross stream range over several tens metres per second, and the particle flow rate varies between 2.3 and 25 times that of the carrier gas. Under these conditions the particles were found to separate from the carrier gas. Therefore, they should be treated as free particles, although the carrier gas transports them to an effective injection point. Thus, there are several possible situations which require different methods of analysis. Problems remaining for further study are outlined. Author (GRA)

N76-32513# City Univ. of New York.
JET-DRIVEN INSTRUMENTS AND THE EDGETONE Interim Report
Harry E. Rauch 1975 26 p refs
(Grant AF-AFOSR-2063-71; AF Proj. 9749)
(AD-A023193; AFOSR-76-0150TR) Avail: NTIS CSCL 20/4

On the basis of observations due to Coltman and Powell a simplified (linear, small, signal) model of jet action in jet-driven instruments and the edgetone is presented. The model leads, by means of an elementary phase analysis, to very simple and intuitive pictures of the feedback models of Powell and Cremer and Ising. For jet-driven instruments the sole demand that the jet deflection at the edge be in phase with the orifice volume-displacement, without impedance (or any other) analysis, implies the surprisingly accurate formula f = .4 micron/2h for the fundamental frequency f, with jet velocity micron and orifice-edge distance h. For the edgetone, the sole demand that the transverse displacement at the orifice lag the jet deflection at the edge of Pi/2 (Powell's assertion) implies the formula for the frequency of the edgetone operating in the k-th stage, f = (.4micron/h(k-1/4)), which is clearly a first approximation to Brown's empirical formula. Consistency of this jet model with the detailed mathematical analyses of Powell and Cremer and Ising is exhibited. In particular, the necessity of parallel-drive is shown, and additional arguments to support it are advanced. Author (GRA)

N76-32364 Naval Underwater Systems Center, New London, Conn.
FLUID STRUCTURE INTERACTION
A. J. Kalinowski *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 405-452 refs (For availability see N76-32339 23-31)

N76-32375 Los Alamos Scientific Lab., N.Mex.
HELICAL WICK STRUCTURES FOR GRAVITY-ASSIST HEAT PIPES
J. E. Deverall and E. S. Keddy *In* ESA Heat Pipes 1976 p 3-10 refs Sponsored by Energy Res. and Develop. Admin. (For availability see N76-32374 23-31)

N76-32378 Odessa Technological Inst. of Food and Refrigerating Industries (USSR).
LOW TEMPERATURE TWO-PHASE CLOSED THERMOSYPHON INVESTIGATION
Z. R. Gorbis and G. A. Savchenkov *In* ESA Heat Pipes 1976 p 37-45 refs (For availability see N76-32374 23-31)

N76-32379 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
PERFORMANCE INVESTIGATION OF CRYOGENIC HEAT PIPES
W. Molt *In* ESA Heat Pipes 1976 p 49-62 refs Sponsored in part by DFVLR-BPT (For availability see N76-32374 23-31)

N76-32380* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARAMETRIC PERFORMANCE OF CIRCUMFERENTIALLY GROOVED HEAT PIPES WITH HOMOGENEOUS AND GRADED-POROSITY SLAB WICKS AT CRYOGENIC TEMPERATURES
M. Groll, R. B. Pittman, and J. E. Eninger (TRW Systems Group, Redondo Beach, Calif.) *In* ESA Heat Pipes 1976 p 63-76 refs (For availability see N76-32374 23-31)
CSCL 20D

N76-32381 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
MODULAR AXIAL GROOVED HEAT PIPES
H. Koch, H. Kreeb, and M. Perdu *In* ESA Heat Pipes 1976 p 77-82 (For availability see N76-32374 23-31)

N76-32382* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL ANALYSIS OF AXIALLY GROOVED HEAT PIPES
Yasuhiro Kamotani *In* ESA Heat Pipes 1976 p 83-91 refs (For availability see N76-32374 23-31)
CSCL 20D

N76-32383 National Engineering Lab., East Kilbride (Scotland).
MANUFACTURE AND PERFORMANCE OF A WATER FILLED HEAT PIPE WITH A SINTERED COPPER WICK
I. C. Finlay, B. Loy, and D. G. Cree *In* ESA Heat Pipes 1976 p 93-101 refs (For availability see N76-32374 23-31)
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N76-32384 Academy of Sciences (USSR), Moscow.
THE METHOD OF CALCULATION AND INVESTIGATION OF HIGH-TEMPERATURE HEAT PIPE CHARACTERISTICS TAKING INTO ACCOUNT THE VAPOUR FLOW COMPRESSIBILITY, FRICTION AND VELOCITY PROFILE
Y. A. Brovalsky, P. I. Bystrov, and M. V. Melnikov *In* ESA Heat Pipes 1976 p 113-122 refs (For availability see N76-32374 23-31)

N76-32385 Akademiya Nauk BSSR, Minsk.
HEAT PIPES: THEORY AND PREDICTION
M. M. Levitan and L. L. Vasiliev *In* ESA Heat Pipes 1976 p 123-130 refs (For availability see N76-32374 23-31)

N76-32386 Academy of Sciences (USSR), Moscow.
EXPERIMENTAL RADIATOR SECTION WITH HEAT PIPES: CREATION EXPERIENCE, DEVELOPMENT WORK AND LIFE TESTS
A. G. Arakelov, Y. A. Brovalsky, P. I. Bystrov, M. G. Glazunov, A. F. Gekov, I. I. Raikov, L. V. Solovyov, L. M. Reshetko, V. A. Osadchy, M. V. Melnikov et al *In* ESA Heat Pipes 1976 p 131-137 ref (For availability see N76-32374 23-31)

N76-32387 Odessa Technological Inst. of Food and Refrigerating Industries (USSR).
ENGINEERING METHODS OF LOW-TEMPERATURE HEAT PIPE DESIGNING CALCULATIONS
G. F. Smirnov, V. V. Barsookov, and L. N. Mishchenko *In* ESA Heat Pipes 1976 p 141-151 refs (For availability see N76-32374 23-31)

N76-32388 Reading Univ. (England). Engineering and Cybernetics Dept.
DYNAMIC CHARACTERISTICS OF HEAT PIPES
G. Rice and E. Azad *In* ESA Heat Pipes 1976 p 153-164 refs (For availability see N76-32374 23-31)

N76-32391 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
DEVELOPMENT OF A PASSIVE HOT GAS RESERVOIR VARIABLE CONDUCTANCE HEAT PIPE
W. D. Muenzel, M. Groll, and M. Hage *In* ESA Heat Pipes 1976 p 197-205 refs (For availability see N76-32374 23-31)

N76-32393 Pisa Univ. (Italy). Ist. di Fisica Generale ed Applicata.
HEAT PIPES AT THE RANGE OF MODERATE TEMPERATURES WITH GAS PRESENCE
C. Casarosa and E. Latrofa *In* ESA Heat Pipes 1976 p 215-224 refs (For availability see N76-32374 23-31)

N76-32394 Naval Postgraduate School, Monterey, Calif.
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Matthew D. Kelleher and William H. Batts *In* ESA Heat Pipes 1976 p 225-234 refs (For availability see N76-32374 23-31)
(Grant NSF AG-496)

N76-32395 European Atomic Energy Community, Ispra (Italy).
MEASUREMENT OF THE ISOTHERMALITY OF A GAS CONTROLLED HEAT PIPE
J. P. Labrande *In* ESA Heat Pipes 1976 p 235-244 refs (For availability see N76-32374 23-31)

N76-32396 Bell Telephone Labs., Inc., Naperville, Ill.
A VARIABLE CONDUCTANCE HEAT PIPE USING BUBBLE PUMP INJECTION
Charles C. Roberts, Jr. *In* ESA Heat Pipes 1976 p 269-280 refs (For availability see N76-32374 23-31)

N76-32397* Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.
PERFORMANCE CHARACTERISTICS OF ROTATING WICKLESS HEAT PIPES
P. J. Marto *In* ESA Heat Pipes 1976 p 281-291 refs Sponsored in part by NASA and Naval Sea Systems Command (For availability see N76-32374 23-31)

N76-32398 Akademiya Nauk BSSR, Minsk.
CENTRIFUGAL COAXIAL HEAT PIPES
L. L. Vasiliev and V. V. Khrolenok *In* ESA Heat Pipes 1976 p 293-302 refs (For availability see N76-32374 23-31)

N76-32399 University Coll. of Swansea (Wales). Mechanical Engineering Dept.
THEORETICAL AND EXPERIMENTAL ANALYSIS OF NON-CONDENSABLE GAS EFFECTS IN A ROTATING HEAT PIPE
T. C. Daniels and R. J. Williams *In* ESA Heat Pipes 1976 p 303-314 refs (For availability see N76-32374 23-31)

N76-32401 European Atomic Energy Community, Ispra (Italy).
THE GAS CONTROLLED HEAT PIPE AS A TOOL FOR WETTING STUDIES
M. Bader *In* ESA Heat Pipes 1976 p 327-334 refs (For availability see N76-32374 23-31)

N76-32402 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
INVESTIGATION OF CAPILLARY FORCES AND SURFACE TENSION
W. Molt *In* ESA Heat Pipes 1976 p 335-346 refs (For availability see N76-32374 23-31)

N76-32403 European Atomic Energy Community, Ispra (Italy).
CORROSION STUDIES OF TUNGSTEN HEAT PIPES AT TEMPERATURES UP TO 2650 C
F. Geiger and D. Quataert *In* ESA Heat Pipes 1976 p 347-356 refs (For availability see N76-32374 23-31)

N76-32404 Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
COMPATIBILITY AND RELIABILITY OF HEAT PIPE MATERIALS
A. Basiulis, R. C. Prager, and T. R. Lamp *In* ESA Heat Pipes 1976 p 357-372 refs (For availability see N76-32374 23-31)

N76-32405 European Space Research and Technology Center, Noordwijk (Netherlands).
DEVELOPMENT OF ARTERY HEAT PIPES IN EUROPE UNDER ESA SPONSORSHIP
C. J. Savage *In* ESA Heat Pipes 1976 p 373-381 refs (For availability see N76-32374 23-31)

N76-32406 Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik.
LIFETESTS OF ARTERY HEAT PIPES FOR LOW TEMPERATURE RANGE
W. D. Muenzel and C. J. Savage *In* ESA Heat Pipes 1976 p 383-392 refs (For availability see N76-32374 23-31)

N76-32407 International Research and Development Co. Ltd., Newcastle (England).
THE FORMATION OF DIACETONE ALCOHOL DURING LIFE TESTS ON ACETONE HEAT PIPES CONSTRUCTED USING ALUMINIUM AND STAINLESS STEEL
D. A. Reay and M. P. Johnson *In* ESA Heat Pipes 1976 p 393-399 (For availability see N76-32374 23-31)

N76-32408 Institute of Physics and Power Engineering, Obninsk (USSR).
EVAPORATION OF LIQUID METALS FROM CAPILLARY POROUS BODIES
V. I. Subbotin, M. N. Ivanovski, A. P. Kudryavtsev, V. V. Prosvetov, V. P. Sorokin, D. N. Sorokin, and L. M. Prorok *In* ESA Heat Pipes 1976 p 403-411 refs (For availability see N76-32374 23-31)

N76-32409 North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
THE MECHANISM OF HEAT TRANSFER IN THE EVAPORATOR ZONE OF THE HEAT PIPE
H. M. Winston, J. K. Ferrell, and R. Davis *In* ESA Heat Pipes 1976 p 413-423 refs (For availability see N76-32374 23-31)

N76-32410 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
EVAPORATION HEAT TRANSFER IN HEAT PIPES
R. R. Barthelemy *In* ESA Heat Pipes 1976 p 425-436 refs (For availability see N76-32374 23-31)

N76-32411 Q-dot Corp., Dallas, Tex.
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M. A. Ruch and G. M. Grover *In* ESA Heat Pipes 1976 p 439-449 (For availability see N76-32374 23-31)

N76-32412 New Mexico Univ., Albuquerque.
PRELIMINARY DESIGN STUDY OF HEAT PIPE HEAT EXCHANGERS
K. T. Feldman and D. C. Lu *In* ESA Heat Pipes 1976 p 451-461 refs (For availability see N76-32374 23-31)

N76-32413 Akademiya Nauk BSSR, Minsk.
STUDY OF HEAT AND MASS TRANSFER IN HEAT PIPE BASED EXCHANGERS
L. L. Vasiliev, L. P. Grakovich, A. N. Abramenko, O. G. Rasin, P. A. Vityaz, M. A. Litvinetz, and V. G. Kiselev *In* ESA Heat Pipes 1976 p 463-472 ref (For availability see N76-32374 23-31)

N76-32414 Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
FOLLOW-UP ON HEAT PIPE APPLICATIONS
A. Basiulis *In* ESA Heat Pipes 1976 p 473-480 refs (For availability see N76-32374 23-31)

N76-32415 Atomic Weapons Research Establishment, Aldermaston (England). Microcircuit Technology Group.
AN INTEGRAL HEAT PIPE PACKAGE FOR MICROELECTRONIC CIRCUITS
D. J. Dean *In* ESA Heat Pipes 1976 p 481-502 refs Sponsored in part by Dept. of Trade and Ind. (For availability see N76-32374 23-31)
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N76-32416 National Research Inst. for Machine Design, Bechovice (Czechoslovakia). Research Inst. for Rotating Electrical Machines, Brno.
COOLING OF ELECTRICAL MACHINES BY HEAT PIPES
O. Oslejsek and F. Polasek *In* ESA Heat Pipes 1976 p 503-514 refs (For availability see N76-32374 23-31)

N76-32418 National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
SELF DE-ICING NAVIGATION BUOYS USING HEAT PIPES
B. S. Larkin and S. Dubuc (Min. of Transport) *In* ESA Heat Pipes 1976 p 529-535 refs (For availability see N76-32374 23-31)

N76-32419 European Atomic Energy Community, Ispra (Italy).
A PRESSURE CONTROLLED PRECISION THERMOSTAT
C. Bassani and C. A. Busse *In* ESA Heat Pipes 1976 p 537-544 refs (For availability see N76-32374 23-31)

N76-32420 National Engineering Lab., East Kilbride (Scotland).
PERFORMANCE OF A PROTOTYPE ISOTHERMAL OVEN FOR USE WITH AN X-BAND MICROWAVE NOISE STANDARD
I. C. Finlay, D. G. Cree, and D. Blundell (Roy. Radar Estab.) *In* ESA Heat Pipes 1976 p 545-553 refs Sponsored in part by Natl. Phys. Lab. (For availability see N76-32374 23-31)
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N76-32421 AGIP Nucleare, Bologna (Italy).
ANALYSIS AND EXPERIMENTAL EVALUATION OF THE CHARACTERISTICS OF WATER AND SODIUM ANNULAR HEAT PIPES
G. Grassi, P. G. Grassi, D. Monari, G. Coggiola (Ist. di Metrologia G. Colonnetti), L. Crovini (Ist. di Metrologia G. Colonnetti), and R. Perissi (Ist. di Metrologia G. Colonnetti) *In* ESA Heat Pipes 1976 p 555-571 refs (For availability see N76-32374 23-31)

N76-32422 European Atomic Energy Community, Ispra (Italy). Applied Mechanics Div.
DESCRIPTION OF DIFFERENT LEAKTESTS WITH STATIC MET-X SEALS, USING HEAT PIPES
L. Verheyden and K. Klein *In* ESA Heat Pipes 1976 p 573-579 refs (For availability see N76-32374 23-31)

N76-32423 Nijmegen Univ. (Netherlands). Dept. of Dermatology.
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F. A. J. Thiele and D. A. Reay (Intern. Res. and Develop. Co. Ltd., Newcastle-upon-Tyne, Engl.) *In* ESA Heat Pipes 1976 p 581-585 refs (For availability see N76-32374 23-31)

N76-32424* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTERNATIONAL HEAT PIPE EXPERIMENT
Roy McIntosh, Stanford Ollendorf, and William Harwell (Grumman Aerospace Corp., Bethpage, N. Y.) *In* ESA Heat Pipes 1976 p 589-591 (For availability see N76-32374 23-31)
CSCL 20D

N76-32425 European Space Research and Technology Center, Noordwijk (Netherlands).
PERFORMANCE EVALUATION OF THE ESRO HEAT PIPES

INCLUDED IN THE INTERNATIONAL HEAT PIPE EXPERIMENT (IHPE)
W. D. Muenzel (Stuttgart Univ.), C. J. Savage, A. Accensi, and B. G. M. Aalders *In* ESA Heat Pipes 1976 p 593-606 refs (For availability see N76-32374 23-31)

N76-32427 Centre National d'Etudes Spatiales, Toulouse (France).
A HEAT PIPE FLIGHT TEST ABOARD A SOUNDING ROCKET
F. Galzin *In* ESA Heat Pipes 1976 p 621-627 ref (For availability see N76-32374 23-31)

N76-32429* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
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S. Ollendorf and R. McIntosh *In* ESA Heat Pipes 1976 p 647-653 refs (For availability see N76-32374 23-31) CSCL 20D

N76-32430 European Space Research and Technology Center, Noordwijk (Netherlands).
ESA HEAT PIPE TECHNOLOGY PROGRAM
A. Accensi *In* ESA Heat Pipes 1976 p 655-660 refs (For availability see N76-32374 23-31)

N76-32431 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
DEVELOPMENT OF VARIABLE CONDUCTANCE HEAT PIPE RADIATORS
H. Koch and H. Kreeb *In* ESA Heat Pipes 1976 p 661-671 (For availability see N76-32374 23-31)

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N76-32514*# Mississippi State Univ., Mississippi State. Dept. of Electrical Engineering.
A STUDY OF DIGITAL HOLOGRAPHIC FILTER GENERATION Interim Report, Mar. 1975 - Aug. 1976
Malcolm Calhoun and Frank Ingels Aug. 1976 126 p refs (Contract NAS8-31373)
(NASA-CR-120642; MSSU-EIRS-EE-77-1) Avail: NTIS HC $6.00 CSCL 14E

Problems associated with digital computer generation of holograms are discussed along with a criteria for producing optimum digital holograms. This criteria revolves around amplitude resolution and spatial frequency limitations induced by the computer and plotter process. Author

N76-32515*# Westinghouse Research Labs., Pittsburgh, Pa.
ULTRASONIC CORONA SENSOR STUDY Final Report
R. T. Harrold 28 Apr. 1976 47 p refs
(Contract NAS9-14808)
(NASA-CR-150988; HUD-10536-CE) Avail: NTIS HC $4.00 CSCL 14B

The overall objective of this program is to determine the feasibility of using ultrasonic (above 20 kHz) corona detection techniques to detect low order (non-arcing) coronas in varying degrees of vacuum within large high vacuum test chambers, and to design, fabricate, and deliver a prototype ultrasonic corona sensor. Author

N76-32516# Philips Labs., Briarcliff Manor, New York.
DEVELOPMENT OF AN OPTICAL DISC RECORDER Quarterly Technical Report, 1 Oct. - 31 Dec. 1975
G. Kenney, C. Balas, D. Lou, A. Chan, and T. Demetrakopoulos Jan. 1976 27 p refs
(Contract N00014-76-C-0441; ARPA Order 3080)
(AD-A022950; PL-5-VR76-0119) Avail: NTIS CSCL 14/3

The mechanical parts of the recorder were designed and are in the first stages of assembly. The servo electronics were designed and fabricated. A coding study is under way for the design of the record/playback signal processing electronics. An optical system using HeNe lasers for recording and playback has been proposed; a report on this system is given in Appendix A. A study of possible materials for the disc substrate shows that plexiglas (PMMA) would be a good choice. Several mechanisms have been considered for protecting the recording from dust, fingerprints, and scratches. A program for investigating suitable DRAW recording materials has begun. Author (GRA)

N76-32517# Federal Highway Administration, Washington, D.C. Implementation Div.
EVALUATION OF STEEL BRIDGE INSPECTION INSTRUMENTS: ACOUSTIC CRACK DETECTOR (ACD)/MAGNETIC CRACK DEFINER (MCD) Final Report
Anthony M. Lizzio and David S. Nelson Jan. 1976 50 p refs (PB-252323/1; FHWA/RD-76-502) Avail: NTIS HC $4.00 CSCL 13B

The field testing and evaluation are discussed of a steel bridge inspection device developed for FHWA by the Southwest Research Institute and tested in cooperation with ten participating State highway departments including Connecticut, California, Montana, Idaho, Pennsylvania, Ohio, Georgia, Texas, Arkansas, and Virginia. The device was used on various types and ages of steel bridges ranging from wrought iron trusses to modern bridge steels. It is concluded that the disadvantages with conventional nondestructive test equipment have not been eliminated with the ACD/MCD system: that is, extensive operator training is still required, and little or no production rate of inspected members of bridges is feasible. The difficulties encountered in characterizing the ACD unit to the steel being surveyed would limit its practical use to indepth inspections by trained personnel of structural details susceptible to fatigue cracking on relatively new bridges. Cracks observed by visual inspection can be verified and defined on flat smooth surfaces by the ACD/MCD units. GRA

N76-32518# National Bureau of Standards, Washington, D.C.
IMPROVED STRESSING APPARATUS FOR PHOTOELASTICITY MEASUREMENTS Final Report
Albert Feldman and William J. McKean 11 Aug. 1975 4 p refs Repr. from Rev. Sci. Instrum., vol. 46, no. 11, Nov. 1975 p 1588-1589 Sponsored in part by ARPA
(PB-253262/0) Avail: NTIS HC $3.50 CSCL 14B

An improved, direct reading stressing apparatus has been constructed for measuring photoelastic constants. Highly uniform stresses are obtained with minimal specimen tilt. Copyright 1975 by the American Institute of Physics. GRA

N76-32519# National Bureau of Standards, Washington, D.C. Electronic Technology Division.
A TEST METHOD FOR DETERMINING THE EFFECT OF THERMAL TRANSIENTS ON PRESSURE TRANSDUCER RESPONSE Final Technical Note, 1 Jul. 1974 - 31 Mar. 1975
John S. Hilten, Carol F. Vezzetti, J. Franklin Mayo-Wells, and Paul S. Lederer Mar. 1976 58 p refs Sponsored in part by Naval Air Systems Command, Wash., D.C. and Range Commanders Council, White Sands Missile Range, N. Mex.
(PB-252678/8; NBS-TN-905) Avail: NTIS HC $4.50 CSCL 14B

A test method for evaluating the effects of short duration, thermal radiant energy transients on pressure transducer response is described. The method consists of monitoring pressure transducer output as the transducer is exposed to radiation resulting from the ignition of a photographic flashbulb or from the discharge of an electronic flash. The method is intended to serve as an initial screening test. GRA

N76-32520# National Bureau of Standards, Boulder, Colo.
LIQUID-IN-GLASS THERMOMETRY Final Report
Jacquelyn A. Wise Jan. 1976 33 p refs Supersedes NBS-Mono-90
(PB-252679/6; NBS-Mono-150; NBS-Mono-90; LC-75-619230) Avail: NTIS HC $4.00 CSCL 14B

Information of general interest to manufacturers and users of liquid-in-glass thermometers is presented. Instructions explaining how to submit a thermometer to the National Bureau of Standards for calibration are provided, and the techniques and equipment, such as stirred liquid comparison baths, used in the calibration procedures are described. A discussion of important principles of acceptable thermometer design and factors affecting their use is included. Listed are tables of tolerances reflecting good manufacturing practices and reasonably attainable accuracies expected with liquid-in-glass thermometers. The calculation of corrections for the temperature of the emergent stem is given in detail for various types of thermometers and conditions of use. GRA

N76-32521# National Bureau of Standards, Boulder, Colo. Electromagnetics Div.

OPTICALLY STROBED SAMPLING OSCILLOSCOPE Final Report

Robert A. Lawton and James R. Andrews May 1975 6 p refs Repr. from IEEE Transactions on Instrumentation and Measurement, vol. 25, no. 1, Mar. 1976 p 56-60

(PB-252737/2) Avail: NTIS CSCL 14B

An optically strobed sampling oscilloscope is described which uses optical pulses from a GaAs laser diode to strobe a Cr-doped GaAs photoconductor which serves as a sampling gate. This sampling gate was used with a commercial sampling oscilloscope to provide a sampling measurement capability that can measure higher voltages than conventional samples and does not exhibit strobe pulse kickout. Preliminary tests indicate a time resolution, limited by the width of the optical pulse used, of about 100 ps. GRA

N76-32522# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.

FLIGHT TEST OF A MASS STORE DISK AND A HIGH-DENSITY PHASE-ENCODED MAG-TAPE RECORDER ABOARD A TURBOPROP AIRCRAFT

H. H. Grote and D. E. Jackson Sep. 1975 12 p

(PB-250070/0; NOAA-TM-ERL-WMPO-25; NOAA-76012101) Avail: NTIS HC $3.50 CSCL 14C

Flight test results are reported of a Hewlett Packard 7900A disk and a 9-track 1600-bpi phase-encoded magnetic tape recorder. A test system was assembled consisting of both the disk and the tape recorder, together with an HP 2100A central processor, an HP 2748B high speed tape reader, and a Model 33 teletypewriter. The system was then flight tested aboard NOAA's C130-B turboprop aircraft under moderately severe flight conditions. About 40,000 write/read operations were performed on the disk, and 216 passes of the HP tape diagnosis were performed on the tape recorder. It was concluded that the tested equipment can operate successfully during turbulent flight conditions. GRA

N76-32523# National Bureau of Standards, Washington, D.C.

DEVELOPMENT OF A SOLID SORPTION TUBE AND ANALYTICAL PROCEDURE FOR HYDROGEN CYANIDE IN THE WORKPLACE ATMOSPHERE Final Report

Barry C. Cadoff and John K. Taylor Apr. 1976 25 p refs Sponsored in part by Natl. Inst. for Occupational Safety and Health

(PB-253228/1; NBSIR-76-998) Avail: NTIS HC $3.50 CSCL 06I

The development of a sampling tube for collecting HCN in the workplace atmosphere is described. The tube contains 4.0 g of flake NaOH and can be readily fabricated in the laboratory. Details are given concerning the construction and use of the tube and data is presented the TLV, one fifth the TLV, and at the TLV. Analysis of the tube contents using the cyanide ion selective electrode is described. This method is simple, rapid, and relatively free of interferences. Data on the analyses of tubes containing cyanide are described and estimates of the precision and accuracy of the method are given. GRA

N76-32524# National Inst. for Occupational Safety and Health, Morgantown, W.Va. Testing and Certification Lab.

INDUSTRIAL SOUND LEVEL METER INTERNAL NOISE IN dBA TEST

Robert J. Koshut 1975 14 p refs

(PB-252089/8; NIOSH/TC/P-006) Avail: NTIS HC $3.50 CSCL 14B

A test procedure is given to determine the internal noise dBA of industrial sound level meters. Included is a list of the equipment needed to perform the test, the configuration in which the equipment is to be used, and a procedure for determining the internal noise in dBA. GRA

N76-32525# National Bureau of Standards, Boulder, Colo. Electromagnetics Div.

CALIBRATION TECHNIQUES FOR ELECTROMAGNETIC HAZARD METER: 500 MHz TO 20 GHz

Ronald R. Bowman Apr. 1976 38 p refs Sponsored in part by the DOD Calibration Coordination Group, Redstone Arsenal, Ala.

(PB-252971/7; NBSIR-75-805) Avail: NTIS HC $4.00 CSCL 14B

The calibration techniques discussed are suitable for producing fields for calibrating most electromagnetic (EM) hazard meters to within plus or minus 1.0 dB using a minimum of laboratory space and oscillator power. Above about 2.6 GHz, adequate equipment and standards have been available for these calibrations. Below this frequency the large apertures of the usual horn radiators require more power than is available from medium power oscillators. Further, calibrations in closed systems are difficult except at frequencies well below 1 GHz. Thus there is a need for small-aperture gain standards from about 500 MHz to 2.6 GHz. The main portion of the work reported here consists of accurate gain measurements for open-ended hollow waveguide radiators (OEG) for use from 500 MHz to 2.6 GHz. Other characteristics of this type of radiator important for EM hazard meter calibrations were also determined: near-field corrections, reflection coefficients, and aperture scattering. The suitability of the calibration scheme was tested by performing calibration at 2 GHz on an EM hazard meter with both a horn radiator and an OEG radiator. GRA

N76-32526# Naval Weapons Center, China Lake, Calif.

NO-VOLTAGE METER Final Report, Oct. 1973 - Jan. 1975

Michael R. Osburn Feb. 1976 13 p

(AD-A022798; NWC-TP-5822) Avail: NTIS CSCL 14/2

A meter with no power source was designed to make voltage checks on firing lines. The meter will detect 50 millivolts, both AC and DC voltages, and cannot result in voltage transfer to the firing line. Author (GRA)

N76-32527# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

COMPARISON OF RATING TECHNIQUES FOR JFTOT HEATER TUBE DEPOSITS Final Report, Oct. 1973 - Apr. 1975

Charles R. Martel and Royce P. Bradley Oct. 1975 71 p refs (AF Proj. 3048)

(AD-A023524; AFAPL-TR-75-49) Avail: NTIS CSCL 14/2

The Visual Rating method and the ALCOR Mark 8A Tube Deposit Rater, used to rate deposits that form on the Jet Fuel Thermal Oxidation Tester (JFTOT) heater tubes, were compared to each other and to measurements of the deposit thickness. An Auger Electron Spectrometer, used in conjunction with an ion gun (AES/Ion Gun), was used to measure the deposit thickness and composition. Both the Visual Rating method and the Mark 8A Tube Deposit Rater were found to correlate with deposit thickness measurements to a limited degree. The AES/Ion Gun method proved to be a useful laboratory tool for measuring the relative thickness of deposits and the elemental composition of deposits (except for hydrogen and helium). Deposits that have a spectrum of colors (i.e., peacock or rainbow type deposits) were found to be considerably thicker than Code 3 deposits. Thin film light interference was found to be the cause of the peacock associated with these deposits. GRA

N76-32528# Naval Research Lab., Washington, D.C. Chemical Dynamics Branch.

PERSONAL ATMOSPHERIC GAS SAMPLER WITH A CRITICAL ORIFICE. PART 2: SYSTEM FOR HANDLING AND ANALYZING THE GAS FROM THE SAMPLER

H. G. Eaton 22 Mar. 1976 18 p refs Sponsored in part by Natl. Inst. for Occupational Safety and Health, Rockville, Md.

(AD-A023062; NRL-7980-Pt-2) Avail: NTIS CSCL 14/2

A gas handling and analyzing system has been developed to analyze, in the range of 1 ppm, unwanted atmospheric contaminants collected and stored at subambient pressures in a suitable container such as the personal gas sampler developed by NRL for the National Institute for Occupational Safety and Health. One of two subsystems detects individual organic contaminants or, by using a backflush valve, detects the concentration of total hydrocarbons by regrouping the components into one measurable peak. The backflush valve is used also to clean the column after the analysis of individual components prior to subsequent analysis. The other subsystem detects methane and carbon monoxide. GRA

N76-32529# Office of Naval Research, London (England).
EUROMECH COLLOQUIUM 63 ON DESIGN AND APPLICATION OF HOT WIRE ANEMOMETERS
D. M. McEligot (Karlsruhe Univ., West Germany) 9 Mar. 1976 25 p refs Colloq. held at Lyngby, Denmark, 20-22 Aug. 1975
(AD-A023184; ONRL-C-5-76) Avail: NTIS CSCL 14/2

The Colloquium covered the current status of development and application of heated-element anemometry at several European activities. The scope of the Colloquium included: (1) static and dynamic calibration, (2) yaw, temperature, and conduction effects, (3) conditional sampling and signal processing, (4) hot films in low speed flows, (5) hot wires in temperature fields and high speed flows, and (6) three-dimensional and atmospheric flows. The report gives brief summaries of the presentations. GRA

N76-32530# Air Force Weapons Lab., Kirtland AFB, N.Mex.
CONVEX CURVED CRYSTAL SPECTROGRAPH FOR PULSED PLASMA SOURCES Final Report
Erskine J. Burns and Robert H. Day Mar. 1976 28 p refs (AF Proj. 8809)
(AD-A022813; AFWL-TR-75-260) Avail: NTIS CSCL 14/2

The geometry of a convex curved crystal spectrograph as applied to pulsed plasma sources is presented. Also presented are data from the dense plasma focus with particular emphasis on the absolute intensity of line radiations. GRA

N76-32531# Instrument Flight Center, Randolph AFB, Tex.
SOLID STATE INTEGRATED DIGITAL TIMER EVALUATION
James F. Barnette and Gabriel P. Intano Mar. 1976 41 p
(AD-A022638; IFC-TR-76-2) Avail: NTIS CSCL 14/2

The USAF Instrument Flight Center conducted a pilot factors evaluation of the Solid State Integrated Digital Timer. The objectives of the evaluation were: (1) to conduct a pilot factors flight evaluation of the Solid State Integrated Digital Timer's display and multi-mode functions; and (2) to conduct a pilot factors flight evaluation of the Solid State Integrated Digital Timer for its suitability as a timer for navigation and weapon delivery. GRA

N76-32532# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
OPTIMIZATION OF GLOW DISCHARGE DETECTORS Final Report, 20 Nov. 1972 - 19 Nov. 1975
N. H. Farhat and A. K. Chua 1 Feb. 1976 16 p refs
(Grant DA-ARO(D)-31-124-73-G74)
(AD-A022569; ARO-11078.5-EL) Avail: NTIS CSCL 14/2

The detection of electromagnetic energy with glow discharge detectors (GDD's) is analyzed in terms of an indirect enhanced ionization model based on the statistical theory of ionized gases. Theoretical predictions agree very well with experimental observations of responsivity and detectivity in the microwave, millimeter, and visible bands and provide valuable design criteria for the optimization of gdd performance in terms of gas composition, pressure and discharge current over an extremely wide spectral band ranging from the lower microwave to the visible. GRA

N76-32533# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
AN EVALUATION OF SELECTED INSTRUMENTS USED TO MEASURE THE MOISTURE CONTENT OF HARDENED CONCRETE Final Report
Edward F. ONeil and James E. McDonald Feb. 1976 74 p refs
(AD-A022601; WES-TR-C-76-1) Avail: NTIS CSCL 14/2

Six types of gages for measuring moisture content of hardened concrete were studied to determine their behavior in long-term service. They were evaluated with respect to stability of measurement and response to moisture change. The gages were mounted in a 12- by 12- by 18-in. copper box and the box was filled with concrete and a copper lid soldered to it. The gages were monitored for a period of 800 days. For the first 194 days the gages were read in a hermetically sealed environment, then for 326 days (194 to 520 days) the copper lid was removed and the box was exposed to a 50 percent relative humidity atmosphere. From 520 to 722 days, the concrete specimen was exposed to 50 percent relative humidity after being entirely removed from the copper box, and for the last 78 days of the test, from 722 to 800 days, the bare concrete block was monitored in a 100 percent relative humidity atmosphere (fog room). The results of the test indicated that two gages (the ionic barrier moisture gage and the Bouyoucos moisture gage) reacted the most favorably during the entire 800-day test period. Both types of gages gave results that were responsive to environmental changes and stable with respect to time. Author (GRA)

N76-32534# National Inst. for Occupational Safety and Health, Morgantown, W.Va. Testing and Certification Lab.
INDUSTRIAL SOUND LEVEL METER ATTENUATOR TOLERANCE TEST
Alwin Dieffenbach 1975 18 p refs
(PB-252088/0; NIOSH/TC/P-005) Avail: NTIS HC $3.50 CSCL 14B

This test procedure determines the accuracy of the sensitivity range attenuator of industrial sound level meters. Included is a list of the equipment needed to perform the test, the configuration in which the equipment is to be used, and a procedure for determining accuracy of the sensitivity range attenuator. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.

N76-32535 Rochester Univ., N.Y.
STUDY OF ELECTRONS PRODUCED IN LASER INDUCED MULTI-PHOTON IONIZATION OF GAS ATOMS Ph.D. Thesis
Edward Alfred Martin, Jr. 1976 162 p
Avail: Univ. Microfilms Order No. 76-14770

The process of multi-photon ionization of a low pressure gas by a ruby laser light pulse was studied. In particular, the number of electrons and the total energy gained by the electrons from the ionization process itself, and from their subsequent acceleration by the intense ruby laser light, were measured. The number of electrons released was found to have a sixth-order power dependence on the light intensity. A mechanism for the ionization process via a resonant intermediate level is suggested. Two independent techniques were used to measure the energy spectra of the ionization electrons. The first method was based on the time of flight from the interaction region to the detector. In the second method a retarding potential was applied just before the detector. The peak values of the two spectra showed good agreement. Dissert. Abstr.

N76-32536 California Univ., Los Angeles.
MAGNETIC FIELD EFFECTS IN PHOTODISSOCIATION LASERS AND SELF-RELAXATION IN ATOMIC IODINE Ph.D. Thesis
Alfred Tennyson Pritt, Jr. 1976 240 p
Avail: Univ. Microfilms Order No. 76-20210

The calculations used to generate the spectral emission profiles associated with a variety of magnetic field environments are presented. The magnetic hyperfine splitting is determined by diagonalizing the Hamiltonian matrix constructed in the zero field hyperfine representation. Once the energy levels and their corresponding wave functions are found, the relative line strengths of the P-2(1/2) - P-2(3/2) transitions are calculated subject to

the selection rules for magnetic dipole radiation. Appropriate Voigt line shapes are assigned to each transition, scaled according to the appropriate line strengths, and summed to obtain the overall spectrum. Dissert. Abstr.

N76-32537*# Little (Arthur D.), Inc., Cambridge, Mass.
RESEARCH AND DEVELOPMENT FOR IMPROVED LEAD-SALT DIODE LASERS Final Report
Jack F. Butler [1976] 59 p refs
(Contract NAS1-12979)
(NASA-CR-145067) Avail: NTIS HC $4.50 CSCL 20E

A substantial increase in output power levels for lead-salt diode lasers, through the development of improved fabrication methods, as demonstrated. The goal of 1 mW of CW, single-mode, single-ended power output, was achieved, with exceptional devices exhibiting values greater than 8 mW. It was found that the current tuning rate could be controlled by adjusting the p-n junction depth, allowing the tuning rate to be optimized for particular applications. An unexpected phenomenon was encountered when crystal composition was observed to be significantly altered by annealing at temperatures as low as 600 C; the composition was changed by transport of material through the vapor phase. This effect caused problems in obtaining diode lasers with the desired operating characteristics. It was discovered that the present packaging method introduces gross damaging effects in the laser crystal through pressure applied by the C-bend. Y.J.A.

N76-32538*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
PROPAGATION OF A LASER BEAM IN A PLASMA Interim Report
John M. Chapman, Jirair Kevorkian, Loren C. Steinhauer (Math. Sci. Northwest, Inc., Bellevue Mich.), and Juris Vagners Oct. 1975 38 p refs
(Grants NGL-48-002-044; AF-AFOSR-2452-73; AF Proj. 9749)
(NASA-CR-148825; AD-A023261; Rept-75-1; AFOSR-76-0158TR) Avail: NTIS HC $4.00 CSCL 20/5

This paper shows that for a nonabsorbing medium with a prescribed index of refraction, the effects of beam stability, line focusing, and beam distortion can be predicted from simple ray optics. When the paraxial approximation is used, diffraction effects are examined for Gaussian, Lorentzian, and square beams. Most importantly, it is shown that for a Gaussian beam, diffraction effects can be included simply by adding imaginary solutions to the paraxial ray equations. Also presented are several procedures to extend the paraxial approximation so that the solution will have a domain of validity of greater extent. Author (GRA)

N76-32539# Hughes Research Labs., Malibu, Calif.
COAT MEASUREMENTS AND ANALYSIS Final Technical Report, 1 Jul. 1974 - Jul. 1975
James E. Pearson, W. P. Brown, Jr., A. Kokorowski, M. E. Pedinoff, and C. Yeh Mar. 1976 106 p refs
(Contract F30602-75-C-0001; ARPA Order 1279)
(AD-A023479; RADC-TR-76-55) Avail: NTIS CSCL 20/5

Coherent optical adaptive techniques (COAT) have been studied by experiment, by analysis, and by computer simulation. The experiments have utilized a 21-channel, visible-wavelength, multidither COAT system, while the computer simulations have dealt with both multidither (outgoing-wave) and phase-conjugate (return-wave) systems. Thermal blooming and turbulence distortions and complex-target effects (speckle-modulations) have been studied. This report summarizes the status of the 21-channel DARPA/RADC, visible-wavelength, multidither COAT experimental model and associated hardware and its use in the experimental measurements on this contract. Experimental observations with the 21-channel COAT system show that blooming distortions occurring in the first 30% of the focused propagation path can be compensated, leading to roughly a factor of 1.5 increase in peak focused-beam irradiance. Computer simulation of phase-conjugate (return-wave) COAT systems has shown almost no blooming compensation. Experimental measurements of COAT operation with equal transmitter and receiver apertures and semidiffuse, extended-glint scotchlight surfaces have failed to produce any degradation in the system convergence level, even though significant spurious modulations within the dither band were observed in the COAT receiver. GRA

N76-32540# Honeywell Corporate Research Center, Bloomington, Minn.
INVESTIGATION OF MATERIAL DAMAGE: PRESSURE PULSES PRODUCED BY CARBON DIOXIDE LASER RADIATION Interim Report, 15 Dec. 1974 - 14 Dec. 1975
John F. Ready Feb. 1976 80 p refs
(Contract F44620-73-C-0027; AF Proj. 9767)
(AD-A023047; AFOSR-76-0295TR) Avail: NTIS CSCL 20/5

This report describes work performed in a continuing program of investigations on the mechanisms by which high power pulsed CO2 laser radiation interacts with target surfaces. The experimental work has been performed using a pulsed CO2 TEA laser capable of delivering up to 10 to the 9th power/sq cm to the target surface in a pulse of duration around 100 nanoseconds. GRA

N76-32541# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
MINIATURE MOLECULAR FREQUENCY SOURCE Final Report, 15 Nov. 1972 - 15 Aug. 1974
J. J. Gallagher Feb. 1976 66 p refs
(Contract DAAB07-73-C-0065; DA Proj. 1S7-62705-AH-94)
(AD-A023070; ECOM-73-0065-F) Avail: NTIS CSCL 20/5

An investigation has been performed to determine the characteristics of a miniature stabilized CO2 laser. The investigation included studies of miniature CO2 lasers, external frequency modulators, and room temperature 4.3 micrometers detectors. Lamb dip observations in the 4.3 micrometers fluorescence of CO2 have been detected with a 77 InSb detector employing both internal and external fluorescence cells. A small molecular frequency source has been assembled. The critical design parameters for miniature molecular sources are discussed. Small normal mode carbon dioxide lasers (both water cooled and room temperature) have been constructed with resonator lengths of 6 inches and efficiencies in the range of 7.5 - 10%. GRA

N76-32542# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
PROSPECTS FOR PRECISION ACTIVE TRACKING USING A QUADRANT DETECTOR
J. F. Walter Jan. 1976 59 p refs
(Contract N00017-72-C-4401)
(AD-A022714; APL-JHU-TG-1290) Avail: NTIS CSCL 20/5

A general model is developed for an active quadrant tracking system constrained to track the nose or leading edge of incoming missiles and aircraft. The basic system consists of a shortpulse Nd:YAG 1.06-micrometer laser transmitter and a laser receiver with a quadrant avalanche photodiode detector in a direct detection mode. Using the model with carefully selected target, atmospheric, system, and detector parameters, estimates are made of the random tracking errors to be expected under various conditions. The conditions are noted under which tracking errors of 10 micro rad. (maximum) can be expected. Author (GRA)

N76-32543# Avco-Everett Research Lab., Everett, Mass.
METAL VAPOR VISIBLE LASER KINETICS PROGRAM Semiannual Technical Report, Mar. - Aug. 1975
D. Trainor, A. Mandl, and H. Hyman Feb. 1976 100 p refs
(Contract N00014-75-C-0061; ARPA Order 1806)
(AD-A022596) Avail: NTIS CSCL 20/5

The objective of this program is to investigate experimentally and theoretically the important kinetic rate processes pertinent to the development of a high power visible laser. GRA

N76-32544# Naval Research Lab., Washington, D.C.
LOW-TEMPERATURE DEUTERIUM FLUORIDE VIBRATIONAL ENERGY TRANSFER KINETICS Final Report, Jul. 1973 - Jun. 1974
J. K. Hancock, A. W. Saunders, Jr., and W. H. Green Mar. 1976 79 p refs Sponsored in part by AFWL and Army Missile Command
(NRL Proj. C07-01; AFWL Proj. 73-232)
(AD-A022567; NRL-MR-3224) Avail: NTIS CSCL 20/5

The development of high-energy DF chemical lasers at operational temperatures below 300 K has prompted the need

for detailed kinetic studies of DF in this low-temperature regime. The purpose of this memorandum is to report the investigation of DF relaxation measurements at low temperatures using the laser excited vibrational fluorescence technique. The authors have extensively studied the DF(v = 1) self-relaxation rate and the HF(v = 1) quenching rate by DF at: 198, 209, 232, 264 and 296 K. In addition to the above measurements, upper limits have been established to the DF(v = 1) quenching rate in the presence of argon at each temperature. GRA

N76-32545# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
LASER ATTENUATORS FOR THE PRODUCTION OF LOW POWER BEAMS IN THE VISIBLE AND 1.06 MICRON REGIONS Final Report
B. L. Danielson and Yardley Beers Jan. 1976 28 p refs Sponsored in part by Aerospace Guidance and Metrology Center
(Contract CCG-74-92)
(PB-252677/0; NBS-TN-677) Avail: NTIS HC $4.00 CSCL 20E

Some methods are investigated for the accurate attenuation of laser beams to very low levels; approximately 10 to the minus 11th power watts. This work was done at 1.06 and .6471 micrometer, but the conclusions are applicable throughout the visible region as well. Two types of devices are considered: wedged beam splitters and neutral density filters. The theory of the attenuation of a wedged beam splitter is described and some of the errors associated with these devices are discussed. GRA

N76-32546# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
ANALYTICAL INVESTIGATIONS OF THE NEAR, FRESNEL AND FRAUNHOFER ZONES FOR A LASER BEAM Final Report, 16 Jun. - 31 Dec. 1975
Emil Wolf Jan. 1976 14 p refs
(Grant DAHC04-75-G-0195)
(AD-A022570; ARO-13441.4-A-P) Avail: NTIS CSCL 20/6

This is a final report on research carried out under Grant DAHC04-75-G-0195. It deals with the following subjects: Energy transfer by electromagnetic radiation; spectral correlations and cross-spectral purity of light; properties of laser fields; and the phase problem of coherence theory. Abstracts of two publications emanating from this research are included. GRA

N76-32547# Stanford Research Inst., Menlo Park, Calif.
TERNARY FLAME STUDY OF SELECTED OXIDES FOR CHEMICAL LASER POTENTIAL Final Report
Menachem Luria, Donald J. Eckstrom, and Sidney W. Benson Mar. 1976 119 p refs
(Contract F29601-74-C-0071; SRI Proj. PYU-3388; AF Proj. 1256)
(AD-A022857; AFWL-TR-75-194) Avail: NTIS CSCL 20/5

The results of a study investigating the potential of alkali-polyhalide-oxidizer (ternary) flames for producing visible chemical lasers are discussed in this report. The experimental program was satisfactorily carried out after development of a heat-pipe-oven reactor that produced a uniform, static, known concentration of alkali metal vapors. Visible photon yields and, in some cases, excited-state distributions were determined from both molecular and atomic alkali emission for a number of polyhalide-alkali-oxidizer combinations and experimental conditions. From these results, excitation mechanisms and energy transfer processes taking place in the ternary flame environment were deduced. Appendixes A through D are independent articles which detail the experiment, the observations, and the deductions concerning the reactions studied. Author (GRA)

N76-32548# Stanford Univ., Calif. Center for Materials Research.
GENERATION OF COHERENT VUV (VACUUM ULTRAVIOLET) AND SOFT X RAYS Semiannual Report, 1 Aug. 1975 - 31 Jan. 1976
S. E. Harris and J. F. Young Mar. 1976 34 p refs
(Contract N00014-75-C-1175; ARPA Order 2782)
(AD-A022759; SU-CMR-76-3; SU-ML-2542; SU-SAR-1) Avail: NTIS CSCL 20/5

During this reporting period three projects have been active. The first project is a study of three frequency summing in inert gases for the generation of short wavelength radiation. The authors have studied both helium and neon systems; they have concluded that the helium experiment is impractical because of the technical difficulties involved in generating the required wavelength. These difficulties are much less severe for the neon system, because of a natural near-coincidence of a neon non-allowed transition and the 16th harmonic of the Nd:YAG laser frequency. The second project resulted in the first observation of a laser induced inelastic collision. In the experiment, energy was switched from the resonant level of strontium to an excited state level of calcium by the application of a short visible laser pulse. The third project describes studies of thermal velocity charge exchange collisions as a method of selectively exciting strongly forbidden levels of singly ionized column IIA elements, leaving the ground state empty. The authors have successfully demonstrated a charge exchange collisional energy transfer from Mg(+) to the Sr(+)(4(d sup 2)D) metastable level. GRA

N76-32549# Stanford Univ., Calif. Dept. of Electrical Engineering.
LASER PHYSICS AND LASER TECHNIQUES Final Scientific Report No. 1, 1 Apr. 1971 - 31 Dec. 1975
Anthony E. Siegman Feb. 1976 10 p refs
(Contract F44620-71-C-0053; AF Proj. 9751)
(AD-A023129; SU-GL-2533; AFOSR-76-0380TR) Avail: NTIS CSCL 20/5

During the overall period of this contract research on laser physics and laser technique was carried out in the areas of laser mode locking and the generation of ultrashort pulses, dye laser pulses, hollow-cathode gas lasers, and optically pumped gas lasers. These results are documented in a comprehensive bibliography of 14 scientific journal publications. The first visible optically pumped molecular vapor-phase laser was operated. Rotational relaxation and triplet state effects in dye lasers were studied. An 'antiresonant ring' interferometer for laser mode locking and cavity dumping was invented. The transient buildup of mode locking in simultaneously Q-switched and mode-locked lasers was analyzed and experimentally confirmed. During the final year of the program significant advances were made in the optically pumped 546.1 nm mercury laser. Sealed-off laser tubes that should have long shelf and operating life were developed. Operation using dc-excited field-replaceable discharge lamps was obtained. This laser appears very promising as a general purpose low-power green laser source, as a potential visible wavelength standard, and as a laser medium for ring gyroscope applications. Author (GRA)

N76-32550# Stanford Research Inst., Menlo Park, Calif.
STUDIES OF LASER DAMAGE PHENOMENA IN MATERIALS Interim Report, 1 Nov. 1974 - 31 Oct. 1975
T. J. Magee 15 Jan. 1976 72 p refs
(Contract F44620-73-C-0019; AF Proj. 9751; SRI Proj. PYU-2266)
(AD-A023269; AFOSR-76-0157TR) Avail: NTIS CSCL 20/5

Research was completed on the analysis of plasma expansion and momentum transfer at the surface of laser-irradiated targets. Experiments were then conducted on mixed and single crystal KC1 samples to assess the influence of high-energy electrons on the infrared absorption at 10.6 micrometers. The studies included simultaneous CW electron and F-light irradiation to determine the correlation between F-aggregate centers and infrared absorption. In addition, during this period, studies were completed on the identification of scatter and absorption sites responsible for the decreased infrared transmission in polycrystalline ZnSe samples. Preparations have also been made for irradiations of a variety of prototype laser windows, supplied by the Air Force Materials Laboratory, at the NASA-Ames 40 kW CO2 laser facility. This report summarizes progress in these and other areas. Author (GRA)

N76-32551# Hughes Research Labs., Malibu, Calif.
INVESTIGATIONS OF ULTRAVIOLET PHOTOIONIZATION SUSTAINED DISCHARGE FOR GAS LASERS Semiannual Technical Report, 1 Jul. - 31 Dec. 1975
R. C. Lind Mar. 1976 105 p refs
(Contract N00014-73-C-0287; DARPA Order 1807)
(AD-A022564; SATR-6) Avail: NTIS CSCL 20/5

The objectives of this program are to investigate and improve ultraviolet (UV) photoionization plasma conditioning techniques, to perform the demonstration of a UV sustained electrical discharge atmospheric pressure CO2 laser, and to establish scalability limits. Initially, fundamental experiments employing small scale discharge volumes established that in excess of 200 J/1-atm could be input to 1 atm CO2 laser mixture by the UV photoionization of an added low ionization potential organic molecule. These and additional experiments led to conjectures for mixture mean-free paths for certain critical CO2, N2, He tri-n-propylamine mixture ratios on the order of 8 cm. Power extraction and small signal gain measurements were undertaken. The limits of scalability of the UV sustained plasma conditioning technique are being addressed. A scaling model for the UV-sustained laser has been developed. Using the model, predictions of the characteristics of a high average power UV-sustained laser have been made. GRA

N76-32552# Hughes Research Labs., Malibu, Calif.
HF/DF PULSED CHEMICAL LASER DEVICE Final Report
J. V. Parker, R. R. Stephens, and L. D. Hess Mar. 1976 125 p refs
(Contract F29601-73-C-0119; AF Proj. 1256)
(AD-A022454; AFWL-TR-75-103) Avail: NTIS CSCL 02/5

A 2-liter subsonic-flow HF chemical laser has been constructed to evaluate the performance of the H2-F2-He system at high pressures and to investigate the problems associated with repetitive pulsing. While operating in the single pulse mode at F2 dissociation levels of 0.1 to 0.2 percent, output energies of 8 to 12 J/1-atm have been obtained at 120 to 250 Torr with electrical efficiencies of 80 to 120 percent. Operation at pressure in excess of 500 Torr was also obtained with reduced electrical efficiency. Comparisons of experiment with theory show significant discrepancies in laser energies and pulse lengths at low dissociation levels. The indications are that deactivation of the higher vibrational states of HF may be considerably faster than is currently assumed. Studies of combustion phenomena in representative laser mixtures indicate that the equilibrium flame velocities are -25 m/sec and that the propagation of detonation waves may be stopped by several layers of fine mesh screen. Studies of the medium quality show no significant density disturbances for times -5 micro sec after initiation, indicating that operation with short laser pulses will produce good beam quality. Measurements of the laser cavity clearing time indicate that the device could be pulsed at rates in excess of 100 Hz with only minor modifications. Author (GRA)

N76-32553# Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
GCO LASER HOLOGRAPHIC TIRE ANALYZER, YUMA PROVING GROUND, ARIZONA, 3 DECEMBER 1975 Radiation Protection Special Study
James K. Franks 18 Feb. 1976 9 p
(AD-A020649; USAEHA-42-009-76) Avail: NTIS CSCL 06/18

A special study of the optical hazards associated with the use of a Laser Holographic Tire Analyzer was conducted in December 1975. It was determined that during some adjustments of the tire analyzer, operating personnel could be exposed to levels exceeding current long-term-exposure protection standards. Author (GRA)

N76-32554# Pacific-Sierra Research Corp., Santa Monica, Calif.
THE IMPROVEMENT IN TURBULENCE-DEGRADED BEAM QUALITY OBTAINED WITH A TILT-CORRECTING APERTURE Final Report
Richard F. Lutomirski, W. Lee Woodie, and Arthur R. Hines Nov. 1975 38 p refs
(Contract DAAB07-73-C-0237)
(AD-A023199; PSR-512) Avail: NTIS CSCL 20/6

In this report, the degradation in the focal-plane irradiance distribution due to atmospheric turbulence, and the potential improvement realizable by employing a wavefront tilt-correcting aperture is calculated. It has been shown that, when the aperture diameter is of the order of the outer scale of turbulence, virtually no improvement is realized relative to the uncompensated case. For the case when the long-term coherence length is small compared with the diameter, there is considerable improvement over the long-term case; however, the focal-point intensity can still be several decibels down from its vacuum value, implying no better than several times diffraction-limited performance. When the coherence length is not much smaller than the diameter, close to diffraction-limited performance can be expected. Comparisons have also been made of the reduction of on-axis intensity with no compensation, tilt-correction, and a full phase-compensating aperture. It is shown that the effective coherence length of the compensated aperture due to the residual amplitude fluctuations is greater than the long-term coherence length by a factor of the square-root of the Fresnel number of the aperture; for high Fresnel number systems, this larger coherence length results in considerable increases in on-axis intensity. GRA

N76-32555# Raytheon Co., Waltham, Mass. Research Div.
CASTING OF HALIDE AND FLUORIDE ALLOYS FOR LASER WINDOWS Final Report
R. T. Newberg and J. Pappis 15 Feb. 1976 136 p refs
(Contract F19628-74-C-0148; ARPA Order 2669)
(AD-A023460; S-1963; AFCRL-TR-76-0011) Avail: NTIS CSCL 20/6

The problem of residual strain in castings of alkali halides (KCl and SrCl2-doped KCl) and alkaline earth fluorides (CaF2 and SrF2) has been overcome by the development of proper annealing and slow cooling procedures. Semiquantitative analysis of absorption coefficients and scattering centers (produced during improper casting and annealing procedures) has shown a correlation between the two for both the halides at 10 micrometers and fluorides at 5.25 micrometers. Consistently high quality castings of both CaF2 and SrF2 have been fabricated regardless of the starting materials. The dependence of fracture strength on both surface polish and annealing history is evidence that fracture for the fluorides is determined by surface and/or edge flaws. GRA

N76-32556# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
RESEARCH ON MATERIALS FOR HIGH POWER LASER WINDOWS Final Report, 1 May 1972 - 30 Apr. 1975
N. J. Grant, H. K. Bowen, R. M. Cannon, F. A. McClintock, R. M. N. Pelloux, and J. B. VanderSande Dec. 1975 326 p refs
(Contract F19628-72-C-0304; ARPA Order 2055)
(AD-A023068; AFCRL-TR-76-0027) Avail: NTIS CSCL 20/6

Contents: substructure formation in hot forged KCl and KBr; impurity drag theory in grain boundary migration of KCl; space charge contribution to grain boundary diffusion; Design of laser windows using flaw analysis--(Statistical determination of surface flaw density in brittle materials, Users manual for flaw statistics program; generation of g(S) curves, Proof testing of brittle materials by thermal shock); fracture toughness and fatigue; transmission electron microscopy of alkali halides; resultant publications and theses. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N76-32557 Arizona State Univ., Tempe.
A KINEMATIC DESIGN STUDY OF PLANOCENTRIC INVOLUTE GEARING Ph.D. Thesis
James Norman Smith 1976 307 p
Avail: Univ. Microfilms Order No. 76-19831

The kinematic equations of operation of involute gears were developed in a coordinate system based on planocentric gearing. Computer programs were written to present the solutions of these equations in both graphical and numerical form. Computer-produced graphs developed for gear design show the relationships of operating conditions and limits, giving pinion active depth as a function of gear tooth tip radius, with some parameters fixed and isopleths drawn for the others. A computer-produced graph developed specifically to give conditions and limits for shaper generation of gears gives dimensions of pinions [cutters] to run with [cut] a given internal or external gear, giving center distance as a function of the number of pinion teeth, with some parameters

fixed and isopleths drawn for the others. Another computer program calculates all basic kinematic design dimensions for a given gear pair, either internal- or external-toothed, and checks for interferences. Several illustrative examples are given, demonstrating the use of the graphs and program in a variety of gear design problems. Dissert. Abstr.

N76-32558 Purdue Univ., Lafayette, Ind.
A MATHEMATICAL MODEL OF HELMHOLTZ RESONATOR TYPE GAS OSCILLATION DISCHARGES OF TWO-CYCLE ENGINES Ph.D. Thesis
Brahmaji Rao Chowdary Mutyala 1975 157 p
Avail: Univ. Microfilms Order No. 76-20488

A mathematical model for simulation of the thermodynamically actuated acoustic behavior of a small two-cycle engine is developed. A three horsepower, single cylinder, two-cycle engine is used. The mathematical model is developed in two parts. In the first part, a thermodynamic model is developed that takes advantage of power measurements on a prototype engine. This is permissible since the main interests are: (1) noise emission, (2) muffler design, and (3) horsepower loss due to muffler back reaction. In the second part, the acoustic model is developed for determining the pressure oscillations and sound radiation. A lumped parameter, Helmholtz resonator type description, is used. Computed mean pressures in the crankcase, the combustion chamber and the muffler expansion chamber for the total range of load conditions up to full load are given. Theoretical and experimental results of pressure oscillations and sound radiation are compared. Dissert. Abstr.

N76-32559 Michigan Univ., Ann Arbor.
THE EFFECT OF SECONDARY INJECTION ON THE PERFORMANCE AND EXHAUST EMISSIONS OF AN OPEN-CHAMBER DIESEL ENGINE Ph.D. Thesis
Samuel Onuorah Onyegegbu 1976 164 p
Avail: Univ. Microfilms Order No. 76-19211

An experimental survey of the zone and magnitude of secondary injection in a single cylinder research diesel engine fitted with a Bosch type injection system was carried out and the dependence of secondary injection on speed and total fuel delivery (total fuel-air ratio) was defined. It was observed that secondary injection for this engine occurs within the normal operating region, at conditions of simultaneous high speed and load. Experimental test runs were made comparing the performance and emission characteristics of a conventional injection system with its inherent secondary injections and those of a modified injection system designed to eliminate secondary injection. The results indicate in general that secondary injection increases smoke, unburned hydrocarbons, specific hydrocarbon emission, and brake specific fuel consumption while it decreases brake mean effective pressure. No noticeable effects of secondary injection on oxides of nitrogen and exhaust temperature were observed with the comparative condition of same total fuel delivery. Dissert. Abstr.

N76-32560*# Rocketdyne, Canoga Park, Calif.
SPACE SHUTTLE PROTOTYPE CHECK VALVE DEVELOPMENT
G. F. Teller Sep. 1976 297 p refs
(Contract NAS9-13882)
(NASA-CR-150991; R-9840) Avail: NTIS HC $9.25 CSCL 13K

Contaminant-resistant seal designs and a dynamically stable prototype check valve for the orbital maneuvering and reaction control helium pressurization systems of the space shuttle were developed. Polymer and carbide seal models were designed and tested. Perfluoroelastomers compatible with N2O4 and N2H4 types were evaluated and compared with Teflon in flat and captive seal models. Low load sealing and contamination resistance tests demonstrated cutter seal superiority over polymer seals. Ceramic and carbide materials were evaluated for N2O4 service using exposure to RFNA as a worst case screen; chemically vapor deposited tungsten carbide was shown to be impervious to the acid after 6 months immersion. A unique carbide shell poppet/cutter seat check valve was designed and tested to demonstrate low cracking pressure (< 2.0 psid), dynamic stability under all test bench flow conditions, contamination resistance (0.001 inch CRES wires cut with < 1.5 pound seat load) and long life of 100,000 cycles (leakage < 1.0 scc/hr helium from 0.1 to 400 psig). Author

N76-32561# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LEAN MIXTURE ENGINES TESTING AND EVALUATION PROGRAM. VOLUME 2: COMPREHENSIVE DISCUSSION Final Report, May - Dec. 1974
Mack W. Dowdy, Frank W. Hoehn, and Tom G. Vanderbrug Nov. 1975 119 p refs 3 Vol.
(Contract DOT/TSC-RA-74-38-TMP-0223)
(PB-251766/2; JPL-5040-12-Vol-2; DOT-TSC-OST-76-26.2-Vol-2) Avail: NTIS HC $5.50 CSCL 21B

Fuel consumption and emissions data are obtained on the engine dynamometer for the baseline engine, and two lean-burn configurations of the same engine and data comparisons are made. Individual cylinder equivalence ratios are measured to evaluate the cylinder-to-cylinder distribution. Pressure-time traces from individual cylinders are used to get information about ignition delay, combustion duration and cycle-to-cycle pressure variations. Fuel consumption and emissions data for one lean-burn configuration are obtained over the Federal Driving Cycle using a chassis dynamometer, and the results are compared with the stock baseline results. Using experimental results and information from the existing literature, the potential of the 'lean-burn concept' is assessed using the Blumberg-Kummer cycle analysis program. GRA

N76-32562# Foxboro Co., Mass.
PROGRESS IN THE DEVELOPMENT AND UTILIZATION OF FERROGRAPHY
Vernon C. Westcott 31 Dec. 1975 64 p
(Contract N00014-74-C-0135; ARPA Order 2532)
(AD-A023453) Avail: NTIS CSCL 14/2

Particles resulting from the wearing of machine surfaces are recovered with a Ferrograph analyzer. The particles have unique characteristics depending on the material of the wearing surfaces and the wear mode. The principal methods of identifying the materials of individual particles are discussed. Chemical reactions from the gaseous phase appear to offer the possibility of identifying materials on the basis of color without losing the particle morphology. Six regimes of sliding steel wear have been identified. It appears that much research on friction and wear is concerned with regimes that do not obtain in normally running machines. Lubricants may be considered as shifting the load, temperature and speed at which a transition from one regime to another occurs. The combined effects of the physical and chemical properties of the oil may be rated by observing the regime boundaries. The existence of a shear mixed layer is discussed. GRA

N76-32563# Aerospace Corp., El Segundo, Calif. Environmental and Urban Div.
HIGHWAY VEHICLE RETROFIT EVALUATION. PHASE 1: ANALYSIS AND PRELIMINARY EVALUATION RESULTS. VOLUME 1: SECTIONS 1 THROUGH 3 Interim Report, May - Oct. 1974
M. G. Hinton, J. Meltzer, T. Iura, L. Forrest, and A. Burke Nov. 1975 221 p refs 2 Vol.
(Contract F04701-74-C-0075)
(PB-252554/1; DOT-TSC-OST-75-48.1) Avail: NTIS HC $7.75 CSCL 21H

An analysis and preliminary evaluation of selected used-car and light-truck fuel economy retrofit devices was made. Information is provided that depicts the performance characteristics of retrofit devices that have the potential to improve automotive fuel economy. The spectrum of devices includes carburetors, acoustic and mechanical atomizers, lean-bleed devices, vapor injectors, fuel modifications, inlet manifolds, drivetrain components, drag reduction techniques, driver aids, cooling fans, valve timing, tuneups, exhaust-related systems, engine oils, oil additives, and filters. GRA

N76-32564# Aerospace Corp., El Segundo, Calif. Environmental and Urban Div.
HIGHWAY VEHICLE RETROFIT EVALUATION. PHASE 1: ANALYSIS AND PRELIMINARY EVALUATION RESULTS. VOLUME 2: SECTIONS 4 THROUGH 13 AND APPENDIX

Interim Report, May - Oct. 1974
M. G. Hinton, J. Meltzer, T. Iura, L. Forrest, and A. Burke Nov. 1975 190 p refs 2 Vol.
(Contract F04701-74-C-0075)
(PB-252555/8; DOT-TSC-OST-75-48.2) Avail: NTIS HC $7.50 CSCL 21H

More than 20 representative classes of retrofit devices/ concepts/ techniques, including more than 130 specific items, were examined in the course of the study. A major portion of the analysis effort was directed to the evaluation of 16 advanced, novel, or new carburetors which have the potential to improve automotive fuel economy. GRA

N76-32343 Naval Ship Research and Development Center, Bethesda, Md.
TORSIONAL SYSTEMS
N. T. Tsai *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 63-71 refs (For availability see N76-32339 23-31)

N76-32345 Polytechnic Inst. of Brooklyn, N.Y.
CABLE SYSTEMS
Nicholas F. Morris *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 93-101 refs (For availability see N76-32339 23-31)

N76-32352 Wisconsin Univ., Madison.
OPTIMUM DESIGN OF DYNAMIC MECHANICAL SYSTEMS
A. Seireg *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 225-234 refs (For availability see N76-32339 23-31)

N76-32360 Massachusetts Inst. of Tech., Cambridge.
KINEMATIC AND DYNAMIC DESIGN OF MECHANISM
Roger E. Kaufmann *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 337-346 Sponsored by NSF (For availability see N76-32339 23-31)

N76-32365 Franklin Inst. Research Labs., Philadelphia, Pa.
ROTATING MACHINERY
William Shapiro, Garnett C. Horner (Virginia Univ.), and Walter D. Pilkey (Virginia Univ.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 453-496 refs Sponsored in part by AROD (For availability see N76-32339 23-31)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N76-32565*# Structural Composites Industries, Inc., Azusa, Calif.
FILAMENT-REINFORCED METAL COMPOSITE PRESSURE VESSEL EVALUATION AND PERFORMANCE DEMONSTRATION Final Report, Jul. 1972 - Oct. 1975
R. E. Landes May 1976 391 p refs
(Contract NAS3-16770)
(NASA-CR-134975; SCI-75154) Avail: NTIS HC $10.75 CSCL 14D

Two different Kevlar-49 filament-reinforced metal sphere designs were developed, and six vessels of each type were fabricated and subjected to fatigue cycling, sustained loading, and hydrostatic burst. The 61 cm (24 inch) diameter Kevlar-49/ cryoformed 301 stainless steel pressure vessels demonstrated the required pressure cycle capability, burst factor of safety, and a maximum pressure times volume divided by weight (pV/W) performance of 210 J/g (834 000 in-lb/lbm) at burst; this represented a 25 to 30% weight saving over the lightest weight comparable, 6A1-4V Ti, homogeneous pressure vessel. Both the Kevlar/stainless steel design and the 97 cm (38 inch) diameter Kevlar-49/2219-T62 aluminum sphere design demonstrated nonfragmentation and controlled failure mode features when pressure cycled to failure at operating pressure. When failure occurred during pressure cycling, the mode was localized leakage and not catastrophic. Kevlar/stainless steel vessels utilized a unique conical boss design, and Kevlar/aluminum vessels incorporated a tie-rod to carry port loads; both styles of polar fittings performed as designed during operational testing of the vessels. Author

N76-32566# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF METALLIZED POLYCARBONATE AND METALLIZED POLYSULFONE CAPACITORS Final Report, 8 Jun. 1967 - 28 Jan. 1976
Leonard Adelson Feb. 1976 360 p refs
(Contract DAAB05-67-C-2707)
(AD-A023254) Avail: NTIS CSCL 09/1

The objective of the work program for process improvement and testing of production lots of metallized polycarbonate film and metallized polysulfone film hermetically sealed capacitors was to a failure rate under static test conditions with a goal of .002% per 1,000 hours for each dielectric, based on testing 11,500 of each for 10,000 hours. The original contract goal had been .001% per 1,000 hours based on testing 23,000 metallized polycarbonate film capacitors. However, the contract modification deleting 11,500 of metallized polycarbonate film capacitors and substituting 11,500 of metallized polysulfone film capacitors changed the maximum attainable FR for each dielectric to .002% per 1,000 hours. GRA

N76-32567# General American Transportation Corp., Niles, Ill. General American Research Div.
INSPECTION OF NUCLEAR REACTOR WELDING BY ACOUSTIC EMISSION Final Report, Nov. 1974 - Nov. 1975
D. W. Prine and R. N. Clark Feb. 1976 88 p
(Contract AT(49-24)-0187)
(PB-250030/4; NUREG-0035-1) Avail: NTIS HC $5.00 CSCL 14B

The development of equipment design parameters for real time NDE of nuclear power piping welds by means of acoustic emission was undertaken. One calibration and two production tests are documented. The test results show that in-process NDE of nuclear power piping welds by means of acoustic emission is feasible and practical. Acoustic emission is effective for detecting cracking-type flaws during the welding process. Simple digital logic in conjunction with frequency discrimination can eliminate background noises encountered in a production environment. GRA

N76-32568# Rockwell International Science Center, Thousand Oaks, Calif. Science Center.
PROCEEDINGS OF THE ARPA/AFWL REVIEW OF QUANTITATIVE NDE Annual Report, 3 Jun. 1974 - 17 Jul. 1975
Donald O. Thompson Wright-Patterson AFB, Ohio AFML 5 Dec. 1975 849 p refs
(Contract F33615-74-C-5180; AF Proj. 7351)
(AD-A023622; SC595.10AFML-TR-75-212) Avail: NTIS CSCL 14/2

The edited transcripts of the ARPA/AFML Review of Quantitative NDE held on July 15-17, 1975, at the Science Center, Rockwell International, are presented in this document. Several key topics form the core of these presentations and discussions. They include quantitative ultrasonics, adhesives and composites, emissions related to the prediction of failure, and residual stress. In addition a panel discussion is presented related to the role of ultrasonic standards in the emerging quantitative ultrasonics area. It is believed that this document provides a reasonable summary of NDE research and development currently underway in the areas selected for presentation. Author (GRA)

N76-32569# Army Concepts Analysis Agency, Bethesda, Md.
APPLICATION OF LIFE TESTING TECHNIQUES TO DETECTION DATA Final Technical Paper
Carl B. Bates and Jerry Thomas Mar. 1976 66 p refs
(AD-A022464; CAA-TP-76-1) Avail: NTIS CSCL 14/2

Life testing techniques for censored sample data are discussed. Singly and progressive censoring of type I and type II are defined.

The detection phenomenon involving observers not always detecting targets is placed in the framework of progressively censored sampling. Maximum likelihood estimates for the parameters of the two-parameter Weibull distribution are given, and a test statistic is presented for comparing two Weibull distribution fitted to censored sample data. Weibull distributions of sample sizes 500, 250, and 100 with 0, 10, and 20 percent censored are simulated. The shape parameter is varied over the range 1.0 to 3.5, and equality of pairs of the distributions is tested. The relationships between Beta and the Beta difference that is distinguishable are given for each of the three sample sizes. For the largest sample size, at the 0.05-level of significance, the Beta difference that is distinguishable varied from 0.15 for small shape parameter values to 0.38 for large shape parameter values. For the 100 sample size distributions, the Beta difference distinguishable varied from 0.30 to 0.73. Author (GRA)

N76-32570# Florida State Univ., Tallahassee. Dept. of Satistics.
CONVERTING DEPENDENT MODELS INTO INDEPENDENT ONES, PRESERVING ESSENTIAL FEATURES
N. Langberg, F. Proschan, and A. J. Quinzi Jan. 1976 21 p refs
(Grant AF-AFOSR-2581-74; AF Proj. 9769)
(AD-A023238; FSU-Statistics-M367; TR-61; AFOSR-76-0185TR) Avail: NTIS CSCL 14/4

Let T denote the life length of a series system of n components having respective life lengths (T sub 1), ..., (T sub n), not necessarily independent. Necessary and sufficient conditions are given for the existence of a set of independent random variables (H sub I), I a subset of (1, ..., n), such that the life length of the original series system and the occurrence of its failure pattern (set of components whose simultaneous failure coincides with that of the system) have the same joint distribution as the life length of a derived series system of components having life lengths (H sub I) and the occurrence of the corresponding failure pattern of the derived system. The authors also exhibit explicitly the distributions of these independent random variables (H sub I). This extends the results of Miller (University of Missouri Technical Report, 1975) while using more elementary methods. GRA

N76-32571# Electric Power Research Inst., Palo Alto, Calif.
PROCEEDINGS OF NDE EXPERTS WORKSHOP ON AUSTENITIC PIPE INSPECTION Special Report
Feb. 1976 138 p refs Held at Germantown, Md., September 1975
(PB-251100/4; EPRI-SR-30; SR-30) Avail: NTIS HC $6.00 CSCL 13H

The proceedings of a workshop are presented that addressed the problems of inservice inspection of austenitic materials--to identify the weak areas in current nondestructive examination practice and to recommend changes to correct the problem areas. Topics discussed included code requirements, environmental considerations, instrumentation and transducers, calibration standards, fabrication considerations, current research programs, ultrasonic fundamentals, and alternate inspection concepts. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N76-32572 Louisiana Tech Univ., Ruston.
CRITICAL STRESSES IN HORIZONTAL PRESSURE VESSELS Ph.D. Thesis
Robert Fredric Tucker, III 1976 77 p
Avail: Univ. Microfilms Order No. 76-20414

A method of analyzing stresses near supports in cylindrical shells was developed and a typical set of vessels representative of actual containers used in industry was analyzed. A complete set of shell equations was solved and programmed on a digital computer. Results from this analysis were plotted graphically for three areas of the vessel under investigation: near the saddle support, and top and bottom midspan. The results of the two-dimensional analysis confirmed that the simplier methods were conservative near the saddle support, but tended to be unconservative at midspan. The conventional practice of treating a vessel as a cylindrical beam ignores important shell effects in short, thin vessels, but becomes more accurate as the shell becomes long and thick. Dissert. Abstr.

N76-32573 Purdue Univ., Lafayette, Ind.
A COMPLETE NONCONFORMING CONVERGENT DISPLACEMENT FORMULATED SINGULAR FINITE ELEMENT FOR LINEAR ELASTIC STATIC AND DYNAMIC LOADING CRACK PROBLEMS Ph.D. Thesis
John Wilbur Kelley 1975 134 p
Avail: Univ. Microfilms Order No. 76-20458

A complete nonconforming singular finite element was developed in which the stiffness and consistent mass matrices were integrated. A method for mixed mode static stress intensity factor extraction was developed. Convergence was also demonstrated, for the stiffness matrix, through solution for the stress intensity factors of several mode 1 and mixed mode static linear elastic crack problems with known solutions. A method for mixed mode dynamic stress intensity factor extraction was developed. The solutions of the single edge cracked panel with a ramp-to-step load on the surfaces parallel to the crack surfaces and of the centrally cracked panel with a ramp-to-step load on the crack surfaces showed that the maximum dynamic mode 1 stress intensity factor approximately doubled over the static value for those problems with uniform loading. Dissert. Abstr.

N76-32574 Michigan Univ., Ann Arbor.
INELASTIC HYSTERESIS BEHAVIOR OF AXIALLY LOADED STEEL MEMBERS WITH ROTATIONAL END RESTRAINTS Ph.D. Thesis
Dhavajjai Prathuangst 1976 195 p
Avail: Univ. Microfilms Order No. 76-19220

The inelastic hysteresis behavior of axially loaded steel members with symmetrical rotational end springs (connections) is studied. The springs are intended to be a simulation of the connections of a bracing member or a simulation of the end restraints of an axially-loaded member due to other connected members in an actual structure. In the analytical formulation, the plastic hinge concept with plastic moment modified due to axial force is employed for the member and the connections. Initial imperfections in the form of initial plastic rotation angles are introduced in the member. The analysis utilizing approximate expression for curvature and some approximations in geometry of the deformed member yields a closed-form solution. This solution is used for generating hysteresis curves in terms of normalized axial load-axial displacement relationship for the parametric study. The parameters of interest are the connection flexural strength, the connection flexural stiffness, the slenderness ratio and the cross-sectional properties of the member. The results of the study show that the connection strength influences the load resisting characteristics mainly in the inelastic region while the connection stiffness acts mainly in the elastic region. Dissert. Abstr.

N76-32575# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
A STATISTICAL PROCEDURE FOR RE-ANALYSING FATIGUE-TEST-RESULTS AND FOR DERIVING DESIGN DATA, APPLIED TO WELDED JOINTS IN AlMg5
E. Haibach and B. Atzori 1975 13 p refs Reprinted from Aluminum 51, no. 4, 1975 p 267-272
(IIW-13-770-75) Avail: NTIS HC $3.50

Published results from S-N tests on typical kinds of welded joints in AlMg5 and similar materials, comprising a total of 79 test series and of 1,274 individual results, have been re-analyzed on a statistical basis. A unified scatter band of constant slope and constant width was derived, and it was successfully applied to describe all the available test series. In combination with the unified scatter band the evaluation of a characteristic stress amplitude corresponding to 2 x 0.000001 cycles is sufficient to indicate the fatigue strength of the particular test series considered. The scatter distribution of the characteristic stress amplitudes obtained from the collection of comparable test series seems to

be independent of the kind of joint and of the stress ratio. These findings may be directly used to establish more consistent design data. Author

N76-32576# Technische Hogeschool, Delft (Netherlands). Dept. of Aeronautical Engineering.
PREDICTION OF FATIGUE CRACK PROPAGATION IN AIRCRAFT MATERIALS UNDER VARIABLE-AMPLITUDE LOADING
J. Schijve Mar. 1975 27 p refs Presented at ASTM Symp. on Fatigue Crack Growth Under Spectrum Loads, Montreal, 23-24 Jun. 1975
(VTH-193) Avail: NTIS HC $4.00

Loads in service are first discussed after which various types of variable-amplitude loading as applied in test programs are surveyed. The various phenomenological aspects of fatigue damage associated with fatigue cracks are indicated. Interaction effects between cycles of different magnitudes are defined. Methods for measuring interaction effects, examples of interaction effects and possible explanations are reviewed. This includes both tests with simple types of variable-amplitude loading (overloads and step loading) and more complex load-time histories (program loading, random load and flight-simulation loading). New evidence on crack closure is presented. Various types of prediction methods are discussed. Author

N76-32577# Technische Hogeschool, Delft (Netherlands). Dept. of Aeronautical Engineering.
A SPECIMEN FOR A CONSTANT STRESS INTENSITY FACTOR
J. Schijve and A. U. DeKoning May 1975 23 p refs
(VTH-198; ICAF-787) Avail: NTIS HC $3.50

An investigation was made in order to design a simple specimen for which the stress intensity factor (K) is constant for a substantial range of the crack length. Moreover the crack growth direction should be stable without the necessity of side grooves. The geometry adopted was a rectangular specimen with a central crack loaded by two pins. Values of K were determined in three ways: (1) calculations based on an analytical function in the literature, (2) calculations with the finite element method and (3) empirical determination based on observed crack growth rates. The agreement between the latter two methods was good, whereas the first method yielded deviating results. By using the width, the height and the locations of the holes for the two pins an approximately constant K-value for a large range of the crack length was obtained. The tests were carried out on 7075 - T6 sheet material. Author

N76-32578*# Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
PROOF TEST CRITERIA FOR THIN-WALLED 2219 ALUMINUM PRESSURE VESSELS. VOLUME 1: PROGRAM SUMMARY AND DATA ANALYSIS Technical Report, Jul. 1974 - Dec. 1975
R. W. Finger Aug. 1976 161 p refs
(Contract NAS3-18906)
(NASA-CR-135036; D180-20100-2-Vol-1) Avail: NTIS HC $6.75 CSCL 13M

This experimental program was undertaken to investigate the crack growth behavior of deep surface flaws in 2219 aluminum. The program included tests of uniaxially loaded surface flaw and center crack panels at temperatures ranging from 20K (-423 F) to ambient. The tests were conducted on both the base metal and as-welded weld metal material. The program was designed to provide data on the mechanisms of failure by ligament penetration, and the residual cyclic life, after proof-testing, of a vessel which has been subjected to incipient penetration by the proof test. The results were compared and analyzed with previously developed data to develop guidelines for the proof testing of thin walled 2219 pressure vessels. Author

N76-32579*# Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
PROOF TEST CRITERIA FOR THIN-WALLED 2219 ALUMINUM PRESSURE VESSELS. VOLUME 2: CRACK OPENING DISPLACEMENT AND STRESS-STRAIN DATA Technical Report, Jul. 1974 - Dec. 1975
R. W. Finger Aug. 1976 381 p refs
(Contract NAS8-18906)
(NASA-CR-135037; D180-20100-2-Vol-2) Avail: NTIS HC $10.75 CSCL 13M
For abstract, see preceding accession.

N76-32580# Indian Inst. of Tech., New Delhi.
PERFORMANCE OF VISCOELASTICALLY DAMPED MULTILAYER STRUCTURES SUBJECTED TO SHOCK EXCITATION
A. D. Kapur (Punjab Eng. Coll., Chandigarh, India) and B. C. Nakra Mar. 1976 38 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Jan. 1977
Avail: NTIS HC $4.00

The performance of 5-layer, 3-layer and 2-layer damped beams subjected to shock excitation was studied. The analysis was based on the effects of rotary and longitudinal inertias of the beam besides transverse inertia, and employs a 4-element viscoelastic model to describe the properties of the viscoelastic material in shear or direct strains. Author

N76-32581# Technische Hogeschool, Delft (Netherlands). Dept. of Aeronautical Engineering.
THE EFFECTS OF PRE-STRAIN ON FATIGUE CRACK GROWTH AND CRACK CLOSURE
J. Schijve Jul. 1975 15 p refs
(VTH-203; ICAF-788) Avail: NTIS HC $3.50

A single pre-strain (epsilon = 0.03) applied to 2024-T3 material raised the static yield strength from 428 to 480 MN/sq m. The growth rate of a fatigue crack in the pre-strained material was about twice as large as in the material that was not pre-strained. A pre-strain followed by 1,000 high, but still elastic pre-stress cycles did not further increase the growth rate. It was shown by COD measurements that crack closure occurred to a lesser extent in the pre-strained material as compared to the original material. The significance of the increased yield strength for fatigue crack growth is briefly discussed. Author

N76-32582# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
LINEAR ELASTIC FRACTURE MECHANICS AS AN AID IN JUDGING SERVICE FAILURES
W. VonSchuetz 1975 6 p refs Repr. from Berg- und Huettenmaennische Monatshefte, (Vienna), vol. 120, no. 3, 1975 p 91-96 In GERMAN; ENGLISH summary
Avail: NTIS HC $3.50

Requirements to be met by a crack propagation formula are discussed, and the Formann formula is advocated for crack propagation calculations. Examples of service failures are given in which the fracture mechanics approach was used successfully to judge the causes of failure and to prevent further failures. Author

N76-32583# Aeronautical Research Inst. of Sweden, Stockholm.
INFLUENCE OF DETECTED CRACK LENGTH AT INSPECTIONS ON PROBABILITY OF FATIGUE FAILURE OF WING PANEL
Sigge Eggwertz 1975 35 p refs
(FFA-HU-1745-Pt-2; ICAF-834) Avail: NTIS HC $4.00

A statistical model for evaluating the probability of fatigue failure of a wing panel subjected to regular inspections, was established where stochastic variation of the maximum load, fatigue life to crack initiation, residual static strength, and crack length at detection, is taken into account. In a numerical analysis five different distribution functions for the crack length at detection were introduced. These distributions, range in effectiveness from conditions met in laboratory inspection to scheduled service inspection. Two different assumptions concerning the reduction of the residual static strength were studied. The results are given in two tables and three diagrams, which show a considerable influence of the inspection effectiveness, especially for long service lives and inspection intervals exceeding 1,000 flights. The reduction in probability of failure due to crack stoppers is also large for longer service lives, except where the inspection effectivity is very high. Author

N76-32584# Materials Research Labs., Maribyrnong (Australia).
FRACTURE MECHANICS PRINCIPLES
J. C. Ritter May 1976 53 p refs
(REPT-661) Avail: NTIS HC $4.50

Approaches which use fracture mechanics theories to establish the fracture toughness of metallic materials are reviewed. Emphasis is placed on how the underlying concepts and theories are developed and manipulated to give test procedures for measuring fracture toughness parameters. The review covers brittle (elastic) fracture behavior, described by linear elastic fracture mechanics, and ductile (plastic) failure described by general yielding fracture mechanics. Treatments are based upon considerations of energy change in fracture and upon analyses of local stress-strain perturbations at a crack tip. The energy approach is also used to obtain a parameter for crack growth resistance, when slow, stable crack extension replaces a single fracture event. The various approaches are compared, and the advantages and limitations of each as they affect the measurement of fracture toughness are discussed. Author

N76-32585# Sandia Labs., Albuquerque, N.Mex.
APPLICATION OF UNLOADED (FREE) MOTION MEASUREMENTS AND MECHANICAL IMPEDANCE TO VIBRATION TESTING
D. O. Smallwood 1976 12 p refs Presented at the Inst. of Environmental Sciences, Philadelphia, 25 Apr. 1976 Sponsored by ERDA
(SAND-75-5790; Conf-760411-2) Avail: NTIS HC $3.50

A method using unloaded (free) motion measurements is reviewed. Several applications are suggested: (1) the determination of the input force to a test item mounted on a nonrigid test fixture when only the force input to the fixture can be measured; (2) the measurement of the foundation apparent weight when it is not possible to drive the foundation at the load point directly; (3) derivation of the test item motion from the foundation unloaded motion, the foundation apparent weight, and the test item apparent weight; and (4) prediction of the load response from apparent weight measurements and the motion of the foundation with a different load. Also discussed are methods for applying the results to sinusoidal, transient, and random vibrations. ERA

N76-32586# Sandia Labs., Albuquerque, N.Mex.
LIGHT-INITIATED EXPLOSIVE FOR IMPULSE EXPERIMENTS ON STRUCTURAL MEMBERS
Robert A. Benham Jan. 1976 18 p refs
(Contract AT(29-1)-789)
(SAND-75-0516) Avail: NTIS HC $3.50

An experimental technique utilizing spray deposited light-sensitive high explosive was developed for the purpose of delivering impulse loads to mechanical structures. An intense flash of light causes the explosive to detonate, producing a nearly simultaneous, distributed impulse load on the sprayed structure. Simple structures as well as complex systems requiring contoured and/or discontinuous loading were tested. The experimental technique and data obtained from a test on an elastic beam were described and discussed. The experimental data were compared to elastic theory predictions. The good agreement between experiment and theory verifies that this technique can be used satisfactorily for studying the response of structures to impulse loading in the laboratory. Author (ERA)

N76-32587# Kentucky Bureau of Highways, Lexington.
LOADS ON BOX CULVERTS UNDER HIGH EMBANKMENTS: POSITIVE PROJECTION, WITHOUT IMPERFECT TRENCH Interim Research Report
Rick L. Russ Aug. 1975 40 p refs Prepared in cooperation with DOT, Federal Highway Admin., Washington, D.C.
(PB-252564/0; RR-431; FHWA-RD-76-S0466) Avail: NTIS HC $4.00 CSCL 13B

The instrumentation and measurements of settlements and pressures on two box culverts designed without the imperfect trench - one for yielding and one for unyielding foundation conditions is reported. The structures were primarily instrumented for comparison with three structures previously constructed which were designed using the imperfect trench method. Pressures on the two structures generally exceed the product of the unit weight of the overlying material and its height. The imperfect trench is generally effective in reducing loads. GRA

N76-32588# Little (Arthur D.), Inc., Cambridge, Mass.
ENERGY CONSERVATION IN NEW BUILDING DESIGN. AN IMPACT ASSESSMENT OF ASHRAE STANDARD 90-75
Mar. 1976 274 p refs
(Contract FEA-CO-04-50173-00)
(PB-252639/0; FEA/D-76/078; FEA/D-CP/43B; Paper-43B) Avail: NTIS HC $9.00 CSCL 13A

The energy, economic, and institutional impacts are assessed that may result from the broad voluntary adoption of ASHRAE standard 90-75 by individual building regulator, authorities. This standard is the first major voluntary consensus standard dealing with energy use in new buildings and is available for optional acceptance by state and local governments. With strict use of the standard, annual energy consumption would be reduced in all building types and locations. The effects of ASHRAE 90-75 on building energy consumption, its influences on physical changes in the buildings, its implications on the owning and operating costs of buildings, its potential impact on the nation's energy consumption in construction, its possible economic impact on several selected markets and participants within the construction sector, and its impact on building habitability are discussed. GRA

N76-32589# Louisiana Dept. of Highways, Baton, Rouge. Research and Development Section.
TEXTURING OF CONCRETE PAVEMENTS Interim Report, Jun. 1974 - Jun. 1975
Joseph E. Ross and Sheldon M. Law Oct. 1975 74 p refs Prepared in cooperation with the Federal Highway Admin., Baton Rouge, La.
(PB-252329/8; LA-72-3C(B)-1; FHWA/LA/RR-98) Avail: NTIS HC $4.50 CSCL 13B

The findings of the Category II experimental concrete texturing project are presented. Under this plan of experimental study, several texturing techniques were tried in order to determine which concrete pavement texture will perform best in regard to skid resistance, durability and uniformity. GRA

N76-32590# Missouri Univ., Kansas City. Dept. of Geosciences.
THE DEVELOPMENT AND UTILIZATION OF UNDERGROUND SPACE
E. J. Parizek 1975 202 p refs Proceedings of the Symp. held at Kansas City, Mo., 5-7 Mar. 1975 Sponsored in part by NSF
(PB-252812/3; NSF/RA/T-75-051) Avail: NTIS HC $7.75 CSCL 13B

These proceedings constitute an essentially verbatim report of the technical papers, panel presentations, and informal questions and answers given during a three-day symposium on the Development and Utilization of Underground Space held in Kansas City, Missouri, March 5-7, 1975. For more than 20 years Greater Kansas City has been the acknowledged world leader in the successful development and use of the subsurface for purposes such as warehousing, freezer storage, manufacturing, and office and laboratory space. Because of this Kansas City can be properly described as an expansive 'laboratory' where many facets of these operations can be observed and studied. The purpose of the symposium was to provide an opportunity for interested and involved persons to see and discuss the current status of underground space use at Kansas City and to relate its successful development here to the areas from which they come. GRA

N76-32591# Catholic Univ. of America, Washington, D.C. Vitreous State Lab.
STRUCTURAL RELAXATION IN VITREOUS MATERIALS
C. T. Moynihan, P. B. Macedo, C. J. Montrose, P. K. Gupta, and M. A. DeBolt Feb. 1976 53 p refs
(Contract N00014-75-C-8056; NR Proj. 022-007)
(AD-A022639; TR-5) Avail: NTIS CSCL 11/2

A phenomenological treatment of the kinetics of the structural relaxation in liquids in the glass transition region in response to isobaric temperature changes is described. The important features of the treatment are accounting for the non-linear character of

the relaxation by allowing the relaxation times to depend both on temperature and on structure and the use of the superposition principle to deal with thermal histories which involve a number of temperature changes or a continuous change in temperature with time. Analysis of experimental data on the evolution of macroscopic properties for a number of different thermal histories is presented for a number of different glass formers. The technique of study of the kinetics of longitudinal strain relaxation by digital correlation spectroscopy is described briefly and typical results presented. GRA

N76-32592# Sydney Univ. (Australia). Civil Engineering Labs.

REPEATED LOADING OF COMPOSITE BEAMS

J. W. Roderick Feb. 1976 52 p refs

(PB-252921/2; R-280) Avail: NTIS HC $4.50 CSCL 13M

Tests are described of push-out specimens and simply supported composite T beams incorporating 19 mm welded studs and subjected to repeated loading. The push out specimens are subjected to both constant amplitude and variable amplitude loading, and the beams to variable amplitude loading only. The progressive failure of the beams is examined and predictions are made using the simple cumulative damage rule. The effect of slip is included in the computation of forces acting on the studs. GRA

N76-32593# Purdue Univ., Lafayette, Ind. School of Civil Engineering.

ACTIVE CONTROL OF BUILDING STRUCTURES SUBJECTED TO WIND LOADS

Smanchai Sae-Ung and James T. P. Yao Oct. 1975 88 p refs

(Grants NSF GK-36196; NSF ENG-75-11162)

(PB-252414/8; CE-STR-75-2) Avail: NTIS HC $5.00 CSCL 13M

The objective of this investigation is to study the feasibility of applying active control forces to building structures which are subjected to wind excitation. The criteria for human comfort and safety were chosen as a result of a literature review. A vibrational model of multistory building structures was studied through the use of the Monte Carlo method. Two different measures were used to indicate the energy requirement for active control. On the basis of a limited number of sample functions, one feedback control law for comfort and another for safety were found to be feasible. GRA

N76-32594# Bureau of Reclamation, Denver, Colo. Engineering and Research Center.

POLYMER IMPREGNATION OF NEW CONCRETE BRIDGE DECK SURFACES. INTERIM USER'S MANUAL OF PROCEDURES AND SPECIFICATIONS Interim Report

W. G. Smoak Jun. 1975 31 p

(PB-252422/1; FHWA/RD-75-72) Avail: NTIS HC $4.00 CSCL 13B

A technique of impregnating new concrete bridge deck surfaces with an acrylic polymer to a depth of 1-inch (25mm) or more for protection against chloride ion intrusion and freeze thaw deterioration is reported. The process technology, materials, equipment, and safety provisions used in the technique are discussed, with the objective of informing potential users of the various steps necessary to insure successful field application of the process. An appended materials and performance specification is included. GRA

N76-32595# Virginia Highway and Transportation Research Council, Charlottesville.

TWO COURSE BONDED CONCRETE BRIDGE DECK CONSTRUCTION. AN EVALUATION OF THE TECHNIQUE EMPLOYED Interim Report, Jun. 1974 - Jan. 1975

Samuel S. Tyson and Michael M. Sprinkel Nov. 1975 73 p refs

(PB-252338/9; VHTRC-76-R13) Avail: NTIS HC $4.50 CSCL 13B

A two course bonded technique was used to construct six bridge decks in Virginia. The overlay concretes selected for use as wearing courses included a latex modified concrete, a high quality PCC, and a wire fiber reinforced concrete. Based on comparisons of two course and single lift construction techniques, the following conclusions are made: An overlay should be placed not sooner than two days after a base layer is placed. Light sandblasting of the base layer removes laitance that might adversely affect the bond between the base layer and overlay. A bonding layer of cement slurry should be broomed onto the base layer not further than 10 feet nor longer than 15 minutes ahead of the overlay placements. GRA

N76-32596# California Univ., Berkeley. Earthquake Engineering Research Center.

ANSR-1. GENERAL PURPOSE PROGRAM FOR ANALYSIS OF NONLINEAR STRUCTURAL RESPONSE

Digambar P. Mondkar and Graham H. Powell Dec. 1975 165 p refs

(Grant NSF GI-36387)

(PB-252386/8; EERC-75-37) Avail: NTIS HC $6.75 CSCL 13B

ANSR is a general purpose computer program for static and dynamic analysis of nonlinear structures. This report documents the features and organization of the current version of the program. The theoretical formulations and solution schemes used in the program are described, and details are given about the structure and organization of the auxiliary program for adding new finite elements to the program. Several examples are presented to illustrate the scope of ANSR. The user's manual for the program is described. GRA

N76-32597# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

PHOTOMECHANICS METHODS FOR INELASTIC STRESS ANALYSIS Final Report, 1 Feb. 1974 - 31 Jan. 1976

Loren W. Zachary and William F. Riley 1 Mar. 1976 60 p refs

(Grant DAHC04-74-G-0105)

(AD-A022613; ISU-ERI-73-33; ARO-11766.3-E) Avail: NTIS CSCL 11/9

In this report, complete mechanical and optical properties are presented for a polyester material which is suitable for model studies in the inelastic range of material response. Data from a series of uniaxial tensile and compressive tests, together with data from a series of pressurized thin-walled cylinder tests, indicates that the fringe order at a point in the material is a function of the instantaneous principal strain difference at the point. Under load, the function is non-linear and multi-valued. Upon removal of the load, however, the retained fringe order is a single-valued linear function of the principal strain difference. Data from the uniaxial and cylinder tests also indicates that the material follows a modified von Mises yield criterion which accounts for differences in tensile and compressive yield strengths. GRA

N76-32598# Southwest Research Inst., San Antonio, Tex.

NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Interim Scientific Report, Jan.-Dec. 1975

F. N. Kusenberger, G. A. Matzkanin, P. H. Francis, and J. R. Barton Mar. 1976 67 p refs

(Contract F44620-75-C-0042; AF Proj. 9782; SWRI Proj. 15-4163)

(AD-A023126; AFOSR-76-0384TR) Avail: NTIS CSCL 14/2

The magnetic field perturbation method has been further developed as a nondestructive means for quantitatively characterizing fatigue cracks in high strength ferromagnetic steels in order to assess their fracture criticality; supplementary techniques used include ultrasonic surface waves and Barkhausen noise analysis. Rod-type tensile specimens of AISI4340 steel were used in the investigations. Results show the magnetic perturbation signal amplitude to be linearly related to the crack opening displacement and the width of the signal to be correlated with the crack depth. Using a fracture mechanics model, the configuration of the small scale yielding plastic zones adjacent to the crack interface and the monotonic and reversed flow plastic zones in the vicinity of the crack tips were calculated. Measurements were made of the variations in the width of the satellite component of the magnetic perturbation signal for various conditions of applied stress and peak cyclic stress. Comparison of these results to the calculated plastic zones indicate that there may be a relation between the width of the satellite component and the plastic zones around a fatigue crack. Results

of Barkhausen noise measurements also show a qualitative correlation with the calculated plastic zones, although refinement of the instrumentation will be needed to better define these relationships. GRA

N76-32599# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THERMAL BUCKLING OF UNIFORM RECTANGULAR PLATES Final Technical Report, Sep. 1974 - Jun. 1975
Robert E. Kielb Feb. 1976 89 p refs
(AD-A023472; ASD-TR-75-37) Avail: NTIS CSCL 20/11

The extensive utilization of light-weight alloys in many structures such as aircraft, ships, and nuclear powerplants necessitates a thorough analysis of the load-deformation relationships of the structural components. Of these relationships, the problem of instability is among the more difficult and interesting ones to analyze. For high temperature environments, the instability due to thermal expansion becomes more important and compelling from a safety and performance standpoint. Elastic instability phenomena of two basic structural elements, rods (columns) and plates, have been extensively studied in the past fifty years and are well documented insofar as the current status is concerned. The analysis of column instability and post-instability is generally considered complete except for the inelastic behavior of the material. For plate structures, the analysis has not reached the same level of completeness. Exact solutions have not been available for certain loading and boundary conditions. The purpose of this report is to present the exact solution for the thermal buckling of uniform rectangular plates. The solutions are presented for all possible combinations of simply supported and clamped edge conditions. This filled a void existing in plate buckling analysis. Author (GRA)

N76-32600# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVESTIGATION OF NATURAL FREQUENCIES OF CIRCULAR PLATES WITH MIXED BOUNDARY CONDITIONS M.S. Thesis
Floyd G. Hemmig Dec. 1975 61 p refs
(AD-A023172; GAE/MC/75-1i) Avail: NTIS CSCL 20/11

An investigation was conducted to determine the effect on fundamental frequency of changes in the boundary conditions of circular plates. Two cases were investigated; the circular plate, clamped on part of its boundary and simply-supported on the remainder; and the circular plate, clamped on part of its boundary and free on the remainder. The methods of analysis used were; experimental measurement using laser holography, finite-element, and a modal approximation. Results were compared for the different methods and with some results available in the current literature. GRA

N76-32601# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
LOW AND HIGH FREQUENCY AIRCRAFT GUNFIRE VIBRATION: PREDICTION AND LABORATORY SIMULATION Final Report, 1 Oct. 1972 - 11 Dec. 1974
Robert W. Sevy and Elbert E. Ruddell Dec. 1975 219 p refs
(AF Proj. 329A)
(AD-A023619; AFFDL-TR-74-123) Avail: NTIS CSCL 20/11

This study describes in-house efforts with two primary objectives: (1) Generation of a gunfire-induced vibration prediction model that defines the equipment vibration spectrum in terms of four low frequency sinusoidals superimposed on a high frequency random vibration field; and (2) Synthesis of an economic laboratory test method by which the spectral characteristics of the prediction model are simulated. In the process, a flexible prediction function is introduced to the technology as a promising vehicle through which more accurate and realistic vibration fields might be predicted and portrayed in the future. A gunblast power model is invoked, from previous work, that relates vibration magnitude and spectral character of the aircraft structural response to the gun power parameters and the distance separating the equipment from the gun muzzles. The test method development necessitated modification of existing commercial vibration equipment resulting in general improvement of the vibration system, as a whole. The prediction technique and test method, developed in this program, is being integrated into MIL-STD-810C and will appear as Method 519.2. GRA

N76-32602# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THREE DIMENSIONAL SHOCK WAVES AND THEIR BEHAVIOR IN ELASTIC FLUIDS Final Report
Peter J. Chen and Thomas W. Wright Mar. 1976 27 p refs
(DA Proj. 1W1-61102-AH-43)
(AD-A022480; BRL-1865) Avail: NTIS CSCL 20/11

In this paper, the properties of three-dimensional shock waves are considered. First, the kinematical aspects of shock and, the implications of balance of mass and balance of linear momentum are reviewed, then, the behavior of shock waves propagating in elastic fluids are examined. After deriving the expression for the shock speed, growth and decay behavior of the shock amplitude is considered. In particular, it is shown that the time rate of change of the shock amplitude depends on the wave form immediately behind the front and the mean curvature of the wave surface as well as the shock strength itself. Finally, compatibility conditions are derived that must be satisfied by the variation of the amplitude in the shock surface and the wave form behind the shock. These conditions are shown to imply that particle paths beyond the shock will be curved in the direction of decreasing amplitude. Author (GRA)

N76-32603# Ballistic Research Labs., Aberdeen Proving Ground, Md.
COMPUTATIONAL PREDICTIONS OF SHOCK DIFFRACTION LOADING ON AN S-280 ELECTRICAL EQUIPMENT SHELTER
Richard E. Lottero Mar. 1976 49 p refs
(DA Proj. 1W1-62118-AH-75)
(AD-A022804; BRL-MR-2599) Avail: NTIS CSCL 20/11

The Los Alamos Scientific Laboratory, under contract to the BRL, utilized a three-dimensional, transient, hydrodynamics computer program, BAAL, developed at LASL, to compute the diffraction loading versus time caused by a one-dimensional 34.475 kPa (5.0 psi) overpressure steady shock wave striking an S-280 Electrical Equipment Shelter. The results of this computation have been placed on a magnetic tape at the BRL. Copies of this tape are available on request. The tape includes an alphanumeric introduction describing the data on the tape and overpressure - time histories for each computational flow field cell that has a coincident face with either the shelter front, top, back, or side face. Also included on the tape is the time history of the resultant force due to overpressure and its effective point of application for each face. Although there are no direct experimental data available for comparison, the pressure - time histories generated appear to be quite good, with the possible exceptions of apparent pressure anomalies at the shelter edges where the flow undergoes a rapid 90 degree expansion, and the late - time pressures computed. Author (GRA)

N76-32604# Harry Diamond Labs., Adelphi, Md.
A NASTRAN SIMULATION OF TEMPERATURE DEPENDENT VISCOELASTIC STRESS-WAVE PROPAGATION
Thomas H. Zimmerman Feb. 1976 26 p refs
(DA Proj. 1W6-62616-AH-77; HDL Proj. A77591)
(AD-A023205; HDL-TR-1741) Avail: NTIS CSCL 20/11

A NASTRAN computer program is developed to model the one-dimensional stress-wave propagation in a viscoelastic bar exhibiting temperature-dependent material properties. Verification experiments were performed on methylmethacrylate rods with different temperature distributions and lengths by impacting the instrumented rod with an air-gun-launched projectile. The computer program is considered to be essential to the design of rain-erosion-resistant radomes for extended range artillery fuzes. Author (GRA)

N76-32340 California Univ., Davis. Dept. of Mechanical Engineering.
MULTIPLE ENERGY DOMAIN SYSTEMS
Dean Karnopp *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 3-7 refs (For availability see N76-32339 23-31)

N76-32341 University of South Florida, Tampa.
TRANSFER FUNCTION ANALYSIS
James C. Bowers and Gary A. Shaw *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 9-44 refs (For availability see N76-32339 23-31)

N76-32342 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DYNAMICS OF SPACECRAFT STRUCTURES
Leonard Meirovitch *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 45-61 refs (For availability see N76-32339 23-31)

N76-32346 Bechtel International Corp., San Francisco, Calif.
OFFSHORE STRUCTURES ANALYSIS
V. Dunder and G. Belonogoff *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 103-128 refs (For availability see N76-32339 23-31)

N76-32347 Texas Univ., Austin.
FRAMES
R. R. Craig, Jr. and C. P. Johnson *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 129-150 refs (For availability see N76-32339 23-31)

N76-32348 Sandia Labs., Albuquerque, N.Mex.
NONLINEAR TRANSIENT RESPONSE OF SOLIDS
Walter Herrmann *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 151-172 refs (For availability see N76-32339 23-31)

N76-32349 Tokyo Univ. (Japan).
TIME DEPENDENT MATERIALS
Yoshiaka Yamada *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 173-188 refs (For availability see N76-32339 23-31)

N76-32353 Lockheed Missiles and Space Co., Palo Alto, Calif.
MECHANICAL AND THERMAL SHOCK ANALYSIS
Philip Underwood *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 235-246 refs (For availability see N76-32339 23-31)

N76-32354 Lummus Co. Canada Ltd., Toronto.
RANDOM VIBRATION OF STRUCTURES
C. Sundarajan *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 247-252 refs (For availability see N76-32339 23-31)

N76-32355 Pratt and Whitney Aircraft, East Hartford, Conn.
BEAMS
Andrew Jay *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 253-272 refs (For availability see N76-32339 23-31)

N76-32356 Westinghouse Research Labs., Pittsburgh, Pa.
PIPING SYSTEMS
C. Visser and A. J. Molnar *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 273-298 refs (For availability see N76-32339 23-31)

N76-32357 Naval Postgraduate School, Monterey, Calif.
DYNAMIC BUCKLING OF STRUCTURES
Robert E. Ball *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 299-321 refs (For availability see N76-32339 23-31)

N76-32358 Los Alamos Scientific Lab., N.Mex.
LIMITING PERFORMANCE OF STRUCTURAL SYSTEMS
Paul D. Smith and Walter D. Pilkey (Virginia Univ.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 323-328 refs (For availability see N76-32339 23-31)

N76-32359 Texas A&I Univ., Kingsville.
GRILLAGES
Thein Wah *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 329-336 refs (For availability see N76-32339 23-31)

N76-32367 Lehigh Univ., Bethlehem, Pa.
SHELL ANALYSIS
Arturs Kalnins and Lawrence I Weingarten (Sandia Labs., Albuquerque, N. Mex.) *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 507-525 refs Sponsored in part by ERDA (For availability see N76-32339 23-31)

N76-32370 Stanford Research Inst., Menlo Park, Calif.
FRACTURE AND FRAGMENTATION UNDER SHOCK LOADING
Lynn Seaman *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 563-577 refs (For availability see N76-32339 23-31)

N76-32372 Tufts Univ., Medford, Mass.
DAMPING
Frederick C. Nelson and Rober Greif *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 603-623 refs (For availability see N76-32339 23-31)

N76-32373 Pennsylvania State Univ., University Park.
INERTIA MATRICES FOR FINITE ELEMENTS
Vernon H. Neubert *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 625-649 refs (For availability see N76-32339 23-31)

42 GEOSCIENCES (GENERAL)

N76-32605# Woods Hole Oceanographic Institution, Mass.
NOTES ON THE 1975 SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS AT THE WOODS HOLE OCEANOGRAPHIC INSTITUTION. VOLUME 1: COURSE LECTURES
1975 85 p refs
(Contract NSF DES-73-06506)
(PB-253160/6; WHOI-75-58-Vol-1) Avail: NTIS HC $5.00 CSCL 08G

A partial listing of topics includes: plate tectonics; models of mantle convection; hydromatics of the earth's core; basic dynamo theory; philosophies of approaching the hydromagnetic problem; details of spreading ridges; variation of ocean floor bathymetry with age; reliability of oceanic heat flow data; structural geology and flow instabilities; evidence for non-Newtonian rheology in the asthenosphere; turbulent convection; free boundary problems; effect of gravitational tides on a model earth's core; displacement and rectification of planetary fluids; thermally-driven large scale ocean circulation; problems in mantle convection. Author (GRA)

N76-32606# Woods Hole Oceanographic Institution, Mass.
NOTES ON THE 1975 SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS AT THE WOODS HOLE OCEANOGRAPHIC INSTITUTION. VOLUME 2: FELLOWSHIP LECTURES
1975 152 p refs
(Contract NSF DES-73-06506)
(PB-253161/4; WHOI-75-58-Vol-2) Avail: NTIS HC $6.75 CSCL 08G

A partial listing of topics includes; nonlinear Rayleigh Taylor instability; gravitational tides in the earth's core; instability of a baroclinic boundary jet in a rotating fluid; convection waves; plate motion and thermal instability in the asthenosphere; development of the thermal structure of the plates; inertial convection at low Prandtl number and fluid dynamics of ridge crests. Author (GRA)

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N76-32607*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

[PHOTOINTERPRETATION OF SKYLAB IMAGERY] Final Report, 1 Jun. 1975 - 31 May 1976
D. A. Landgrebe, Principal Investigator 1976 278 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-14016)
(E76-10470; NASA-CR-147856) Avail: NTIS HC $9.25 CSCL 05B

There are no author-identified significant results in this report.

N76-32608*# California State Dept. of Water Resources, Sacramento.
[WATER QUALITY CONDITIONS IN SAN FRANCISCO BAY DELTA] Progress Report
Randall L. Brown, Principal Investigator 22 Sep. 1976 1 p ERTS
(Contract NAS5-20945)
(E76-10486; NASA-CR-148792; PR-5) Avail: NTIS HC $3.50 CSCL 05B

There are no author-identified significant results in this report.

N76-32609*# Delaware Univ., Newark.
VARIABILITY OF WETLAND REFLECTANCE AND ITS EFFECT ON AUTOMATIC CATERGORIZATION OF SATELLITE IMAGERY
Vytautas Klemas, Principal Investigator, David S. Bartlett, Robert H. Rogers (Bendix Aerospace Systems Div., Ann Arbor, Mich.), and Navinchandra Shah (Bendix Aerospace Systems Div., Ann Arbor, Mich.) 16 Sep. 1976 3 p ERTS
(Contract NAS5-20983)
(E76-10488; NASA-CR-148794) Avail: NTIS HC $3.50 CSCL 08B

The author has identified the following significant results. A technique for training automated analysis of satellite multispectral data based on in situ measurements of target reflectance was tested and applied in delineating cover communities in Delaware's tidal wetlands. Land cover categorization of data from the same overpass in four test wetland areas was carried out using a four category classification system. The tests indicate that training data based on in situ reflectance measurements and atmospheric correction of LANDSAT data can produce comparable accuracy of categorization to that achieved using more conventional relative radiance training. Analysis of the four wetlands cover categories (salt marsh cordgrass, salt hay, water, and unvegetated tidal flat) produced average categorization accuracies of 82.1% by conventional relative radiance training and 81.4% by use of in situ reflectance measurements.

N76-32610*# Atomic Energy Commission, Dacca (Bangladesh).
INVESTIGATIONS USING DATA FROM LANDSAT-2 Quarterly Report, Apr. - Jun. 1976
Anwar Hossain, Principal Investigator Aug. 1976 34 p refs Sponsored by NASA ERTS
(E76-10496; NASA-CR-148802) Avail: NTIS HC $4.00 CSCL 05B

The author has identified the following significant results. Preliminary land use maps of Sunamgonj, Baniachong, and Srimongal areas in the Sylhet districts were prepared. Indication of new land in southern Patuakhali district and Hatiya island were found, and erosion in the northern part of Hatiya island is also shown.

N76-32611*# Old Dominion Univ. Research Foundation, Norfolk, Va.
CORRELATION OF CHLOROPHYLL, SUSPENDED MATTER, AND RELATED PARAMETERS OF WATERS IN THE LOWER CHESAPEAKE BAY AREA TO LANDSAT-1 IMAGERY Final Report, Aug. 1972 - Nov. 1974
P. Fleischer, Principal Investigator, D. E. Bowker (NASA. Langley Res. Center), W. G. Witte, T. A. Gosink, W. J. Hanna, and J. C. Ludwick Aug. 1976 131 p refs ERTS
(Contract NAS5-21816)
(E76-10497; NASA-CR-148803) Avail: NTIS HC $6.00 CSCL 08J

The author has identified the following significant results. An effort to relate water parameters of the lower Chesapeake Bay area to multispectral scanner images of LANDSAT 1 has shown that some spectral bands can be correlated to water parameters, and has demonstrated the feasibility of synoptic mapping of estuaries by satellite. Bands 5 and 6 were shown to be useful for monitoring total particles. Band 5 showed high correlation with suspended sediment concentration. Attenuation coefficients monitored continuously by ship along three baselines were cross correlated with radiance values on three days. Improved correlations resulted when tidal conditions were taken into consideration. A contouring program was developed to display sediment variation in the lower Chesapeake Bay from the MSS bands.

N76-32612*# Commission of the European Communities, Ispra (Italy).
AGRICULTURAL RESOURCES INVESTIGATIONS IN NORTHERN ITALY AND SOUTHERN FRANCE (AGRESTE PROJECT). PART 1: ACTIVITY PERFORMED ON THE ITALIAN TEST-SITES Progress Report, 15 Feb. - 15 May 1976
J. Megier, Principal Investigator 15 May 1976 38 p refs Sponsored by NASA ERTS
(E76-10499; NASA-CR-148819; PR-3) Avail: NTIS HC $4.00 CSCL 05B

The author has identified the following significant results. Some qualitative results were obtained out of the experiment of reflectance measurements under greenhouse conditions. An effort was made to correlate phenological stages, production, and radiometric measurements. It was found that the first order effect of exposure variability to sun irradiation is responsible for different rice productivity classes. Effects of rice variety and fertilization become second order, because they are completely masked by the first order effects.

N76-32613*# Commission of the European Communities, Ispra (Italy).
AGRESTE PROGRAM. PART 2: FRENCH TEST-SITES Progress Report, Mar. - Jun. 1976
T. LeToan and P. Cassirame, Principal Investigators Jun. 1976 29 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E76-10500; NASA-CR-148820) Avail: NTIS HC $4.00 CSCL 02C

There are no author-identified significant results in this report.

N76-32614*# Alaska Univ., College.
IDENTIFICATION OF FLOOD HAZARD RESULTING FROM AUFEIS FORMATION IN AN INTERIOR ALASKAN STREAM
W. J. Stringer, Principal Investigator, T. H. George, and R. M. Bell [1976] 15 p refs Sponsored by NASA and Dept. of Agriculture Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Grant NGL-02-001-092)
(E76-10501; NASA-CR-148821) Avail: NTIS HC $3.50 CSCL 08H

There are no author-identified significant results in this report.

N76-32615*# Environmental Research Inst. of Michigan, Ann Arbor.
WHEAT PRODUCTIVITY ESTIMATES USING LANDSAT DATA Progress Report, 16 May - 15 Aug. 1976
Richard F. Nalepka, John Colwell, Principal Investigator, and Daniel P. Rice 15 Aug. 1976 23 p ERTS
(Contract NAS5-22389)
(E76-10502; NASA-CR-148822; ERIM-114800-20-L) Avail: NTIS HC $3.50 CSCL 02C

There are no author-identified significant results in this report.

N76-32616*# Instituto Geofisico del Peru, Lima.
DIGITAL PROCESSING OF SATELLITE IMAGERY APPLICA-

TION TO JUNGLE AREAS OF PERU Final Report, 1973 - 1975

Jose C. Pomalaza, Principal Investigator, Carlos A. Pomalaza, and Jorge Espinoza 24 Feb. 1976 84 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10504; NASA-CR-148824; IGP-ARSI-76) Avail: NTIS HC $5.00 CSCL 05B

The author has identified the following significant results. The use of clustering methods permits the development of relatively fast classification algorithms that could be implemented in an inexpensive computer system with limited amount of memory. Analysis of CCTs using these techniques can provide a great deal of detail permitting the use of the maximum resolution of LANDSAT imagery. Potential cases were detected in which the use of other techniques for classification using a Gaussian approximation for the distribution functions can be used with advantage. For jungle areas, channels 5 and 7 can provide enough information to delineate drainage patterns, swamp and wet areas, and make a reasonable broad classification of forest types.

N76-32617*# Arizona Univ., Tucson. Office of Arid Lands Studies.

APPLICATIONS OF REMOTE SENSING TECHNIQUES TO COUNTY LAND USE AND FLOOD HAZARD MAPPING

Robin B. Clark, Jeffery S. Conn, David A. Miller, and David A. Mouat Nov. 1975 35 p refs

(Grant NGL-03-002-313)

(NASA-CR-147978; Bull-12) Avail: NTIS HC $4.00 CSCL 08B

The application of remote sensing in Arizona is discussed. Land use and flood hazard mapping completed by the Applied Remote Sensing Program is described. Areas subject to periodic flood inundation are delineated and land use maps monitoring the growth within specific counties are provided. Author

N76-32618*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LANDSAT US STANDARD CATALOG, 1-30 APRIL 1976

30 Apr. 1976 142 p

(NASA-TM-X-74151; NTISUB/B/138-76/004;

GSFC/LU-76/004) Avail: NTIS HC $6.00 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT-1 and LANDSAT-2 coverage, respectively. Author

N76-32619*# Virginia Inst. of Marine Science, Gloucester Point.

APPLICATIONS OF REMOTE SENSING TO ESTUARINE MANAGEMENT Annual Report

John C. Munday, Jr., Hayden H. Gordon, Christopher S. Welch, and Gaynor Williams Jul. 1976 138 p refs

(Grant NGL-47-022-005)

(NASA-CR-148826; AR-4) Avail: NTIS HC $6.00 CSCL 08C

Projects for sewage outfall siting for pollution control in the lower Chesapeake Bay wetlands are reported. A dye-buoy/photogrammetry and remote sensing technique was employed to gather circulation data used in outfall siting. This technique is greatly favored over alternate methods because it is inexpensive, produces results quickly, and reveals Lagrangian current paths which are preferred in making siting decisions. Wetlands data were obtained by interpretation of color and color infrared photographic imagery from several altitudes. Historical sequences of photographs are shown that were used to document wetlands changes. Sequential infrared photography of inlet basins was employed to determine tidal prisms, which were input to mathematical models to be used by state agencies in pollution control. A direct and crucial link between remote sensing and management decisions was demonstrated in the various projects. Author

N76-32620*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

REMOTE SENSING IN MICHIGAN FOR LAND RESOURCE MANAGEMENT Annual Report, 1 Jun. 1975 - 31 May 1976

D. S. Lowe, L. B. Istvan, N. E. G. Roller, and V. L. Prentice Sep. 1976 78 p refs Original contains color illustrations

(Grant NGR-23-005-552)

(NASA-CR-148828; ERIM-193400-13-P) Avail: NTIS HC $5.00 CSCL 08F

The Environmental Research Institute of Michigan is conducting a program whose goal is the large-scale adoption, by both public agencies and private interests in Michigan, of NASA earth-resource survey technology as an important aid in the solution of current problems in resource management and environmental protection. During the period from June 1975 to June 1976, remote sensing techniques to aid Michigan government agencies were used to achieve the following major results: (1) supply justification for public acquisition of land to establish the St. John's Marshland Recreation Area; (2) recommend economical and effective methods for performing a statewide wetlands survey; (3) assist in the enforcement of state laws relating to sand and gravel mining, soil erosion and sedimentation, and shorelands protection; (4) accomplish a variety of regional resource management actions in the East Central Michigan Planning and Development Region. Other tasks on which remote sensing technology was used include industrial and school site selection, ice detachment in the Soo Harbor, grave detection, and data presentation for wastewater management programs. Author

N76-32621*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXCERPTS FROM SELECTED LANDSAT 1 FINAL REPORTS IN GEOLOGY

Nicholas M. Short, A. Smith (GE Space Div., Glendale, Md.), and R. Baker (GE Space Div., Glendale, Md.) Apr. 1976 79 p

(NASA-TM-X-71119; X-923-76-74) Avail: NTIS HC $5.00 CSCL 08G

The standard formats for the summaries of selected LANDSAT geological data are presented as checklists. These include: (1) value of LANDSAT data to geology, (2) geologic benefits, (3) follow up studies, (4) cost benefits, (5) optimistic working scales, (6) statistical analysis, and (7) enhancement effects. F.O.S.

N76-32622*# Geological Survey, Denver, Colo.

SKYLAB-EREP STUDIES IN COMPUTER MAPPING OF TERRAIN IN THE CRIPPLE CREEK-CANON CITY AREA OF COLORADO

Harry W. Smedes, K. Jon Ranson (Colorado State Univ.), and Roland L. Holstrom (Martin Marietta Aerospace Corp., Denver, Col.) [1975] 77 p refs Original contains color illustrations

(NASA Order T-9612-B)

(NASA-CR-147844) Avail: NTIS HC $5.00 CSCL 08B

Multispectral-scanner data from satellites are used as input to computers for automatically mapping terrain classes of ground cover. Some major problems faced in this remote-sensing task include: (1) the effect of mixtures of classes and, primarily because of mixtures, the problem of what constitutes accurate control data, and (2) effects of the atmosphere on spectral responses. The fundamental principles of these problems are presented along with results of studies of them for a test site of Colorado, using LANDSAT-1 data. Author

N76-32623*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

THE SIGNIFICANCE OF THE S-193 SKYLAB EXPERIMENT USING PRELIMINARY DATA EVALUATION

Kumar Krishen Mar. 1975 76 p refs

(Contract NAS9-12200)

(NASA-CR-150989; LEC-4250) Avail: NTIS HC $5.00 CSCL 05B

The Skylab S-193 radiometer/scatterometer/altimeter experiment is described. The spaceborne microwave system acquires simultaneous radiometric brightness temperature and radar backscatter data over land and ocean. Application of the data analysis to the planning of the GEOS-C and SEASAT-A programs, observation of hurricane Ava, and evaluation of the

sensor inflight performance are discussed in terms of using operationally the spaceborne microwave sensors for sensing earth resources phenomena. J.M.S.

N76-32624*# Caspan Corp., Houston, Tex.
[SELECTED IMAGERY FROM EARTH RESOURCES SURVEY PROGRAM] Final Report
1976 23 p
(Contract NAS9-14702)
(NASA-CR-150990) Avail: NTIS HC $3.50 CSCL 05B

Preparation of LACIE documents for data base entry and indexing of imagery from selected Earth Resources Survey Program sources is described. J.M.S.

N76-32625*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING OF SOIL MOISTURE WITH MICROWAVE RADIOMETERS, 2
T. Schmugge, T. Wilheit, W. Webster, Jr., and P. Gloerson Washington Sep. 1976 38 p refs
(NASA-TN-D-8321; G-76114) Avail: NTIS HC $4.00 CSCL 08M

Results are presented that were derived from measurements made by microwave radiometers during the March 1972 and February 1973 flights of National Aeronautics and Space Administration (NASA) Convair-990 aircraft over agricultural test sites in the southwestern part of United States. The purpose of the missions was to study the use of microwave radiometers for the remote sensing of soil moisture. The microwave radiometers covered the 0.8- to 21-cm wavelength range. The results show a good linear correlation between the observed microwave brightness temperature and moisture content of the 0- to 1-cm layer of the soil. The results at the largest wavelength (21 cm) show the greatest sensitivity to soil moisture variations and indicate the possibility of sensing these variations through a vegetative canopy. The effect of soil texture on the emission from the soil was also studied and it was found that this effect can be compensated for by expressing soil moisture as a percent of field capacity for the soil. The results were compared with calculations based on a radiative transfer model for layered dielectrics and the agreement is very good at the longer wavelengths. At the shorter wavelengths, surface roughness effects are larger and the agreement becomes poorer. Author

N76-32626# World Meteorological Organization, Geneva (Switzerland).
HYDROLOGICAL NETWORK DESIGN AND INFORMATION TRANSFER
1976 190 p refs Proc. of the WMO Intern. Seminar held at Newcastle-upon-Tyne, UK, 19-23 Aug. 1974; sponsored in part by Intern. Assoc. of Hydrol. Sci.
(WMO-433; OHR-8; ISBN-92-63-10433-6) Avail: NTIS HC $7.50; WMO, Geneva, Sw. Fr. 30

The seminar consisted of two parts - an open forum comprising seven sessions each dealing with a distinct topic in hydrological network design followed by discussions; and a workshop consisting of six sessions dealing with network design problems related to streamflow, precipitation and evaporation gages. Each session consisted of a brief introduction to the topic in question, followed by a classroom excercise, based on a real case study. For individual titles, see N76-32627 through N76-32640.

N76-32627 Geological Survey, Reston, Va.
OBJECTIVES AND APPROACHES IN HYDROLOGICAL NETWORK PLANNING AND DESIGN
W. Hofmann *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 9-14 refs (For availability see N76-32626 23-43)
Copyright.

General remarks are made concerning networks for hydrometeorological data acquisition. The uses for hydrometeorological data which influence the network requirements are reviewed and other factors having a bearing on the design, such as costs, benefits, and length of observation time are also noted. ESA

N76-32628 Southern Water Authority, Worthing (England).
DATA TIME INTERVALS IN HYDROLOGY
P. W. Herbertson *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 17-19 refs (For availability see N76-32626 23-43)
Copyright.

The uses of hydrological data are reviewed and the need for and effect of various data time intervals on the accuracy of the data are discussed, based on results of surveys in the U.S.A. and Great Britain. The data recording systems are described and fixed-time and fixed-interval recording is briefly considered. ESA

N76-32629 Geological Survey, Reston, Va.
DECISION THEORY AND ITS APPLICATION TO NETWORK DESIGN
Marshall E. Moss *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 23-25 refs (For availability see N76-32626 23-43)
Copyright.

A brief discussion is presented on decision theory and Bayesian statistics. The role the latter can play in the optimum design of networks for hydrological data is considered. ESA

N76-32630 Research Inst. for Water Resources Development, (VITUKI), Budapest (Hungary).
DETERMINATION OF EXPECTED INFORMATION LOSSES DUE TO SAMPLING OF HYDROLOGICAL RECORDS IN TIME/SPACE USING BAYESIAN DECISION THEORY
A. Szoelloesi-Nagy *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 27-43 refs (For availability see N76-32626 23-43)
Copyright.

The information requirements of a hydrological data network are outlined. The ways in which decision theory based upon Bayesian statistics can meet these requirements by supplying knowledge about the information losses due to data sampling is discussed. ESA

N76-32631 Geological Survey, Reston, Va.
REGRESSION ANALYSIS AND PARAMETER IDENTIFICATION
N. C. Matalas *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 47-50 refs (For availability see N76-32626 23-43)
Copyright.

The use of regression analysis for hydrological information transfer is discussed. With the technique, estimates of the values of a statistical parameter, such as the mean, derived from historical records at the gaged sites, are regressed on physiological and meteorological variables associated with the sites. Problems relating to the compounding of model and time errors in the procedure of network design using regression analysis are also considered. ESA

N76-32632 Waterloo Univ. (Ontario).
REGIONAL MAPPING AND CLIMATIC INFLUENCE IN DATA TRANSFER METHODS
S. I. Solomon *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 57-62 refs (For availability see N76-32626 23-43)
Copyright.

Regional mapping - the delineation on maps of regions having a common hydrological property - can be used in data transfer and network planning at three levels of sophistication: simple presentation of recorded or processed data; isoline, polygon or digital maps; multiregionalization. The latter - designated as model-homogeneous regions in Canada - are discussed with, in particular, consideration of climatic factors. ESA

N76-32633 Newcastle-upon-Tyne Univ. (England). Dept. of Civil Engineering.
INTEGRATED NETWORKS AND THE INFLUENCE OF ERROR IN PRECIPITATION AND EVAPORATION DATA ON STREAMFLOW PREDICTION
P. Johnson *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 65-75 refs (For availability see N76-32626 23-43)
Copyright.

How interpolation of data in a streamflow network might

be improved by the interpolation of additional information as rainfall and evaporation is considered together with a consideration of the design of integrated data networks. The ways in which the design can be varied are summarized and two approaches - mathematical analysis and simulation - to the estimation of the required density of precipitation and/or evaporation gaging are discussed. Various simulation studies carried out elsewhere are reviewed. ESA

N76-32634 World Health Organization, Geneva (Switzerland).
PROBLEMS OF WATER QUALITY MONITORING
R. Helmer *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 91-98 (For availability see N76-32626 23-43)
Copyright.

The major components and methods of water quality monitoring are reviewed and the present state of water quality monitoring is discussed. WMO activities in the water quality monitoring field are summarized. ESA

N76-32635 Geological Survey, Reston, Va.
STATISTICS OF DATA TRANSFER
N. C. Matalas, E. Todini (IBM, Pisa, Italy), and J. R. Wallis (IBM, Pisa, Italy) *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 103-109 refs (For availability see N76-32626 23-43)
Copyright.

The possibility of regression analysis as a technique for information transfer in water resources (streamflow) investigations is outlined and the use of the technique as a hydrological design tool is illustrated. Discussion is limited to estimating the mean faster than the variance. ESA

N76-32636 Waterloo Univ. (Ontario).
ACCURACY REQUIRED IN DATA TRANSFER
S. I. Solomon *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 111-117 (For availability see N76-32626 23-43)
Copyright.

The main techniques of hydrological data transfer are noted together with their standard errors of estimate percent. The standard error of estimate of the average flow in two locations in Canada is discussed and the cost and duration of carrying out average flow estimates by the noted techniques are given. The accuracy required for data transfer is discussed and a solution to the Canadian problem is worked through. ESA

N76-32637 Geological Survey, Reston, Va.
INFORMATION TRANSFER FOR STREAM DISCHARGE
Marshall E. Moss *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 119-128 refs (For availability see N76-32626 23-43)
Copyright.

The advantages of regression analysis of streamflow parameters are considered and its use as a hydrological network design tool noted. The major steps in the analysis technique are worked through by means of an example. ESA

N76-32638 Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
DESIGN OF NETWORKS AND DATA TRANSFER FOR PRECIPITATION
E. M. Shaw and P. E. OConnell *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 129-150 refs (For availability see N76-32626 23-43)
Copyright.

The stages in the design of a precipitation network are listed together with the type and number of stations required. Three methods of areal rainfall analysis applicable to rain gage network design are presented. These are cross correlation; least squares fitting of polygonials; rainfall surface fitting by the multiquadric method. ESA

N76-32639 State Hydrological Inst. (USSR).
GENERAL PRINCIPLES OF HYDROLOGICAL NETWORK DESIGN
W. Kupriianov *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 151-165 (For availability see N76-32626 23-43)
Copyright.

The requirements that should be met by the number of observation points, the program of observation and the accuracy of measurements in a hydrological network are listed. The general principles to be followed in selecting sites for the distribution of hydrological observation points are set forth. The possibilities offered by mathematical analysis and statistics with regard to regionalization and network planning are considered and the question of observation duration addressed. The selection of water bodies (lakes, reservoirs etc.) for research is discussed together with observational site location. ESA

N76-32640 Newcastle-upon-Tyne Univ. (England).
NETWORK DESIGN AND DATA USE
P. Johnson *In* WMO Hydrol. Network Design and Inform. Transfer 1976 p 167-180 refs (For availability see N76-32626 23-43)
Copyright.

The analysis of data from a streamflow gaging network in the region of the Northumbrian Water Authority, England, related particularly to the estimation of the yield-storage characteristics of a planned reservoir site is discussed. The network of gaging stations and the relevant aspects of each are summarized. The basic data sets and error in estimate of storage are analyzed together with time sampling error and total error in estimated storage. ESA

N76-32641*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT NON-US STANDARD CATALOG, 1-30 APRIL 1976
30 Apr. 1976 138 p
(NASA-TM-X-74150; NTISUB/B/139-76/004; GSFC/LN-76/004) Avail: NTIS HC $6.00 CSCL 05B

For abstract, see preceding accession.

N76-32642# Transportation Research Board, Washington, D.C.
ACQUISITION AND USE OF GEOTECHNICAL INFORMATION Final Report
Dec. 1975 52 p refs Sponsored in part by Am. Assoc. of State Highway and Transportation Office and FHA
(PB-252944/4; TRB/NCHRP/SYN-33; ISBN-0-309-02427-7; LC-76-1350) Avail: NTIS HC $4.00 CSCL 08G

The report presents the results of a comprehensive review and assessment of the current practices of state highway and transportation agencies in the acquisition and use of geotechnical information in route selection, design, and construction of transportation facilities. Information is presented on such matters as planning, conducting, and presenting information from geotechnical investigations, the equipment, procedures, and selection of sampling locations for geotechnical investigations, and the structuring and positioning within the agency framework of the organization that must acquire and use geotechnical information. GRA

N76-32643# Utah Univ., Salt Lake City.
METHODOLOGIES FOR THE DETERMINATION OF STREAM RESOURCE FLOW REQUIREMENTS: AN ASSESSMENT
C. B. Stalnaker and J. L. Arnette Apr. 1976 207 p refs (Contract DI-14-16-008-915)
(PB-253152/3; FWS/OBS-76/03) Avail: NTIS HC $7.75 CSCL 08H

Standard nomenclature is presented, together with an overview of hydrologic techniques, the calculation of essential hydraulic parameters, and determination of other quantitative relationships, including a summary of applicable modeling approaches. Methods are discussed for assessing instream flow needs for fish, terrestrial wildlife, and water quality. Problems of determining the impact of stream flow changes on recreational activities and aesthetic values are considered. GRA

N76-32644# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Earth Sciences.
LAKE ERIE INTERNATIONAL JETPORT MODEL FEASIBILITY INVESTIGATION. REPORT 17-6: APPLICATION OF THREE-DIMENSIONAL HYDRODYNAMIC MODEL TO STUDY EFFECTS OF PROPOSED JETPORT ISLAND ON THERMOCLINE STRUCTURE IN LAKE ERIE

John F. Paul and Wilbert J. Lick Mar. 1976 86 p refs
(Contract DACW39-74-C-0080)
(AD-A022588; WES-CR-H-75-1-6) Avail: NTIS CSCL 08/8

A previously developed three-dimensional, variable-density hydrodynamic model was applied to the Lake Erie area about Cleveland. This application was to investigate the effect of a proposed jetport island on the summer stratification pattern in the nearshore lake area and on the flushing characteristics of the Cuyahoga River outflow into the lake. Initial results obtained from the application of the model are presented. Author (GRA)

N76-32645# Oxy Metal Industries (Intra), Inc., Santa Ana, Calif. Systems Engineering Div.
RESEARCH ON ULTRAFILTRATION SYSTEMS UNDER SEAWATER DESALTING CONDITIONS Final Report, 1 Dec. 1974 - 29 Feb. 1976
John V. Peck, H. Andre Parker-Jones, and John L Richardson Feb. 1976 125 p refs
(Contract DI-14-30-3295)
(PB-253210/9; Pub-R-5004; W76-08117; OWRT-S-76-41) Avail: NTIS HC $5.50 CSCL 07B

The tubular ultrafiltration systems under seawater desalting conditions are evaluated. An experimental investigation was made of the feasibility, both technical and economic, of using tubular ultrafiltration membranes for treating seawater prior to desalination by reverse osmosis. Seawater desalination processes employing reverse osmosis membranes demand extensive pretreatment to prevent surface fouling. The ultrafiltration process is a promising alternative method of pretreatment, both in terms of reliability and total operating costs. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N76-32646 Dartmouth Coll., Hanover, N.H.
COAL1: A DYNAMIC MODEL FOR THE ANALYSIS OF UNITED STATES ENERGY POLICY Ph.D. Thesis
Roger Francis Naill 1976 709 p
Avail: Univ. Microfilms Order No. 76-19860

A technical description of the data and assumptions of COAL1, a system dynamics model constructed to aid in the analysis and design of United States energy policy was presented. The following dynamic mechanisms combine to create a growing gap between domestic energy demand and production in the COAL1 model: (1) a tendency toward exponential growth in the demand for energy; (2) depletion of the domestic oil and gas resource base; and (3) delays and constraints in the development of alternative energy sources such as synthetic fuels, nuclear power or electricity from coal. With no major changes in policy, it was concluded that imports are likely to rise to 50 percent of energy needs by 1985. Only a combined program that stabilizes energy demand and accelerates the use of coal can avoid massive oil and gas imports over the long term. Dissert. Abstr.

N76-32647 Purdue Univ., Lafayette, Ind.
A SILICON SOLAR CELL FOR USE AT HIGH ILLUMINATION INTENSITIES Ph.D. Thesis
Michael Dean Lammert 1975 193 p
Avail: Univ. Microfilms Order No. 76-20467

A p(+)-n(+) structure silicon solar cell, developed for use at high illumination intensities was described. The various losses in solar cells were examined along with possible methods of reducing the losses. These losses were compared in a p(+)-n(+) solar cell and a conventional solar cell. The relative advantages of each type of cell and the possible advantages obtained by using concentrated sunlight also were examined. Results of a computer study of the p(+)-n(+) solar cell were presented showing the effects of bulk lifetime, surface recombination velocity, device thickness, p to n finger width ratio, and illumination intensity. Dissert. Abstr.

N76-32648*# North Carolina State Univ., Raleigh. Semiconductor Device Lab.
A THEORETICAL ANALYSIS OF THE CURRENT-VOLTAGE CHARACTERISTICS OF SOLAR CELLS Annual Report
P. M. Dunbar and J. R. Hauser Aug. 1976 98 p refs
(Grant NGR-34-002-195)
(NASA-CR-148827) Avail: NTIS HC $5.00 CSCL 10A

Various mechanisms which limit the conversion efficiency of silicon solar cells were studied. The effects of changes in solar cell geometry such as layer thickness on performance were examined. The effects of various antireflecting layers were also examined. It was found that any single film antireflecting layer results in a significant surface loss of photons. The use of surface texturing techniques or low loss antireflecting layers can enhance by several percentage points the conversion efficiency of silicon cells. The basic differences between n(+)-p-p(+) and p(+)-n-n(+) cells are treated. A significant part of the study was devoted to the importance of surface region lifetime and heavy doping effects on efficiency. Heavy doping bandgap reduction effects are enhanced by low surface layer lifetimes, and conversely, the reduction in solar cell efficiency due to low surface layer lifetime is further enhanced by heavy doping effects. A series of computer studies is reported which seeks to determine the best cell structure and doping levels for maximum efficiency. Author

N76-32649*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPROVED SOLAR HEATING SYSTEM Patent Application
Ronald N. Jensen, inventor (to NASA) Filed 24 Aug. 1976 13 p
(NASA-Case-LAR-12009-1; US-Patent-Appl-SN-717320) Avail: NTIS HC $3.50 CSCL 10A

A system was proposed for using solar energy to heat the interior of a structure. The system utilizes a low cost solar collector to heat a recirculating air mass which then flows through a series of interconnected ducts and passageways without the use of exterior fans or blowers. Heat is transferred from the air mass to the structure's interior and the air mass is then reheated. NASA

N76-32650*# Alabama Univ., Huntsville. Center for Environmental and Energy Studies.
SOLAR HEATING AND COOLING TECHNICAL DATA AND SYSTEMS ANALYSIS Progress Report, Sep. 1975 - Jun. 1976
D. L. Christensen Jun. 1976 57 p refs
(Contract NAS8-31293)
(NASA-CR-150006) Avail: NTIS HC $4.50 CSCL 10A

The acquisition and processing of selected parametric data for inclusion in a computerized Data Base using the Marshall Information Retrieval and Data System (MIRADS) developed by NASA-MSFC is discussed. This data base provides extensive technical and socioeconomic information related to solar energy heating and cooling on a national scale. A broadly based research approach was used to assist in the support of program management and the application of a cost-effective program for solar energy development and demonstration. Author

N76-32651*# Martin Marietta Aerospace, Denver, Colo.
DEVELOPMENT OF SINGLE CELL PROTECTORS FOR SEALED SILVER-ZINC CELLS, PHASE 1 Final Report, Apr. 1975 - Apr. 1976
Matthew S. Imamura, Richard L. Donovan, John W. Lear, and Bud Murray Sep. 1976 128 p refs
(Contract NAS3-19432)
(NASA-CR-135054; MCR-76-263) Avail: NTIS HC $6.00 CSCL 10C

A single cell protector (SCP) assembly capable of protecting a single silver-zinc (Ag Zn) battery cell was designed, fabricated, and tested. The SCP provides cell-level protection against overcharge and overdischarge by a bypass circuit. The bypass circuit consists of a magnetic-latching relay that is controlled by

the high and low-voltage limit comparators. Although designed specifically for secondary Ag-Zn cells, the SCP is flexible enough to be adapted to other rechargeable cells. Eighteen SCPs were used in life testing of an 18-cell battery. The cells were sealed Ag-Zn system with inorganic separators. For comparison, another 18-cell battery was subjected to identical life test conditions, but with battery-level protection rather than cell-level. An alternative approach to the SCP design in the form of a microprocessor-based system was conceptually designed. The comparison of SCP and microprocessor approaches is also presented and a preferred approach for Ag-Zn battery protection is discussed. Author

N76-32652*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TESTS OF A REDUCED-SCALE EXPERIMENTAL MODEL OF A BUILDING SOLAR HEATING-COOLING SYSTEM
David Namkoong Washington Sep. 1976 23 p refs
(NASA-TM-X-3416; E-8729) Avail: NTIS HC $3.50 CSCL 13B

An experimental solar heating and cooling system model has been built and operated, combining elements that are programmable (e.g., heating and cooling load of a building and collected solar energy) with experimental equipment. The experimental system model was based on the loads and components used in the Solar Building Test Facility (SBTF), which includes a 1394 sq m solar collector field at NASA Langley. These tests covered 5 continuous days under summer conditions. For the system model up to 55 percent of the simulated collected solar energy was used for the building load. This amount of solar energy supplied 35 percent of the building cooling load. Heat loss was significant. If tank heat loss were eliminated, which would make it similar to the actual SBTF, 75 percent of the collected solar energy would be used. This amount would supply approximately 50 percent of the building cooling load. A higher fraction of solar energy is possible with a more performance-optimized system. Author

N76-32653*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
INTERCONNNECT AND BONDING TECHNOLOGIES FOR LARGE FLEXIBLE SOLAR ARRAYS Final Report
26 Jul. 1976 125 p refs
(Contract NAS8-31016)
(NASA-CR-144312; LMSC-D492654) Avail: NTIS HC $5.50 CSCL 14D

Thermocompression bonding and conductive adhesive bonding are developed and evaluated as alternate methods of joining solar cells to their interconnect assemblies. Bonding materials and process controls applicable to fabrication of large, flexible substrate solar cell arrays are studied. The primary potential use of the techniques developed is on the solar array developed by NASA/MSFC and LMSC for solar electric propulsion (SEP) and shuttle payload applications. This array is made up of flexible panels approximately 0.7 by 3.4 meters. It is required to operate in space between 0.3 and 6 AU for 5 years with limited degradation. Materials selected must be capable of enduring this space environment, including outgassing and radiation. Author

N76-32654 Argonne National Lab., Ill.
LITHIUM REQUIREMENTS FOR HIGH ENERGY LITHIUM-ALUMINUM/IRON SULFIDE BATTERIES FOR LOAD-LEVELING AND ELECTRIC-VEHICLE APPLICATIONS
A. A. Chilenskas, G. J. Bernstein, and R. O. Ivins 1976 19 p Presented at the Symp. on United States Lithium Resources and Requirements by the year 2000, Lakewood, Colo., 22-24 Jan. 1975
(Contract W-31-109-eng-38)
(CONF-760112-3) Avail: NTIS HC $3.50

Lithium-aluminum/iron sulfide batteries are being developed for use as energy storage devices on electric utilities and power sources for electric vehicles. Projections are made of the quantity of lithium required for lithium-aluminum/iron sulfide batteries produced during 1985-2000. The projected lithium requirement in the year 2000 represents a substantial fraction of the present estimate of world lithium resources, and is nearly equal to the estimated economically recoverable lithium resources in the U.S. In addition, the potential market for primary batteries using lithium will add to these requirements. Expansion of exploration for new sources and increases in production capacity will be needed to meet the projected lithium requirements for the introduction of these batteries in sufficient quantities to produce the desired impact upon petroleum conservation goals. Author (ERA)

N76-32655# Oak Ridge National Lab., Tenn.
ELECTROCHEMICAL STUDIES OF MASS TRANSPORT IN HIGH-TEMPERATURE ELECTROLYTES
J. Braunstein and C. E. Vallet (Universite de Provence, France) 1975 14 p refs Presented at Battery Workshop, Argonne, Ill., 21 Mar. 1976 Sponsored by ERDA
(CONF-760312-1) Avail: NTIS HC $3.50

Since electrode kinetics are rapid for proposed high-temperature batteries, and since the electrolytes are frequently complex or polymeric, mass transfer polarization becomes a limiting factor in recharge rates. Transport parameters needed for design and modeling studies include interdiffusion coefficients and transference numbers. Methods such as chronopotentiometry were applied almost exclusively to self-diffusion coefficients of dilute constituents. The chronopotentiometric method was developed to provide interdiffusion coefficients over broad ranges of concentration, and the application is illustrated in two kinds of melts: alkali fluoride--beryllium fluoride melts having a polymeric structure, and alkali chloride--aluminum chloride melts having a complex structure. Author (ERA)

N76-32656# Oak Ridge National Lab., Tenn.
REGIONAL COMPARISON OF SAVINGS FROM VARIOUS RESIDENTIAL ENERGY CONVERSION STRATEGIES
J. G. Delene and J. B. Gaston Feb. 1976 69 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5146) Avail: NTIS HC $6.00

The energy use and cost of providing space conditioning to a reference model home in various cities in the United States were calculated for alternate space conditioning systems and for various residential energy conservation strategies. The benefits and costs of increasing the thermal insulation in new and in older homes were estimated, as well as the value of the revised HUD minimum insulation standards compared to their predecessor. The benefits of thermostat setback and improved gas furnace efficiency were estimated from both a resource savings and consumer economic standpoint. The economic analysis included capital and maintenance, as well as costs reflected in the consumer's utility bill. Heating systems considered include heat pump, electric furnace, gas and oil furnaces, and either electric baseboard or ceiling heat. This report is intended to provide basic data for future studies. Such studies include evaluations of the potential effect of energy saving strategies and future shifts in residential heating patterns. Author (ERA)

N76-32657# Oak Ridge National Lab., Tenn.
CHOICE OF WORKING FLUID AND OPERATING CONDITIONS FOR ENERGY CONVERSION WITH GEOTHERMAL HEAT SOURCES
K. R. Landgraf, K. I. Kudrnac, and R. Solares 23 Oct. 1973 68 p refs Sponsored by ERDA
(ORNL-MIT-180) Avail: NTIS HC $4.50

Electric power generating cycles which can be used in conjunction with a low temperature geothermal energy source are presented. A steam/isobutane dual cycle capable of generating 50.7 MW of electric power is proposed. This cycle is optimized using regenerative feed water heating to yield a power output of 52.1 MW or an improvement of 2.8%. Other power cycle design and working fluids are investigated. Working fluids including various freons, steam, isobutane, ammonia, SO2, CO2, and several low molecular weight alkanes and alkenes are considered. The power cycle designs which are investigated include single and dual Rankine cycles as well as topping/bottoming Rankine cycles, and Brayton gas cycles. The investigation shows that use of a single freon-11 cycle results in a 57.7 MW power output representing an improvement of 13.8% over the the LASL proposal. Author (ERA)

N76-32658# Los Alamos Scientific Lab., N.Mex.
SOME PROBLEMS INVOLVED WITH SAMPLING GEOTHERMAL SOURCES
A. K. Stoker and W. D. Purtymun 1975 31 p refs Presented

at Workshop on Sampling Geothermal Effluents, Las Vegas, Nev. 20-21 Oct. 1975
(Contract W-7405-eng-36)
(LA-UR-75-2335; Conf-751086-2) Avail: NTIS HC $4.00

Geothermal wells must be sampled for a variety of purposes including geologic and geochemical interpretation, engineering design of facilities, environmental release evaluation, and documentation of baseline conditions. Basic factors influencing the choice and application of sampling methods are reviewed including the type of the geothermal resource, the analyses of interest, well production parameters, utilization processes, and possible sample contamination or instability. Three basic methods of sampling are described including condensation, phase separation, and use of evacuated containers. Several practical problems experienced by various workers are discussed. These include the natural variability of fluid composition with time, effects of well-bore heat losses, effects of well flow rate and production time, sampling locations, laboratory simulation studies, contamination by corrosion reactions, and documentation of hydrologic systems possibly connected to the geothermal resource.
Author (ERA)

N76-32659# Idaho National Engineering Lab., Idaho Falls.
SPACE HEATING SYSTEMS IN THE NORTHWEST: ENERGY USAGE AND COST ANALYSIS
J. G. Keller and J. F. Kunze Jan. 1976 46 p refs
(Contract E(10-1)-1375)
(ANCR-1276) Avail: NTIS HC $5.50

The question of energy usage and cost of providing space heat in the Northwest is discussed. Though space heating needs represents only 18% of the U.S.'s total energy consumption, it nevertheless appears to offer the greatest potential for conservation and near term applications of alternate energy sources. Efficiency and economic feasibility factors are considered in providing for space heating demands. These criteria are presented to establish energy usage, cost effectiveness, and beneficial conservation practices for space heating of residential, commercial, and industrial buildings. Four Northwestern cities have been chosen whose wide range of climate conditions are used to formulate the seasonal fuel and capital cost and hence the annual heating cost covering a broad spectrum of heating applications, both the traditional methods, the newer alternate forms of energy, and various methods to achieve more efficient utilization of all types. ERA

N76-32660# Sandia Labs., Albuquerque, N.Mex.
ENGINEERING OF WIND ENERGY SYSTEMS
James F. Banas and W. N. Sullivan Jan. 1976 27 p refs
(Contract AT(29-1)-789)
(SAND-75-0530) Avail: NTIS HC $5.00

The engineering of wind energy systems is analyzed from the point of view of component selection and performance assessment. Combinations of two load types (variable and constant speed) and three turbine types connected by a fixed-gear-ratio transmission constitute the various systems investigated. The three turbine types result from introducing the notions of nested, unnested, and hybrid power coefficients suggested by current performance characteristics of American Multiblade, Darrieus, and Darrieus/Savonius turbines. The engineering problems associated with these systems are discussed qualitatively, emphasizing the nature, magnitude, and variability of the problems. Author (ERA)

N76-32661# Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
KINETIC ENERGY STORAGE OF OFF-PEAK ELECTRICITY
L. A. Simpson, I. E. Oldaker, and J. Stermscheg Sep. 1975 72 p refs
(AECL-5116) Avail: ERDA Depository Libraries HC $4.50; Atomic Energy of Can. Ltd., Chalk River HC $1.50

The concept of using large flywheels to store off-peak electricity is considered. The development of high strength composite materials has made possible improvements in the energy storage capacity of such devices. The problems involved in designing large flywheels and their economic advantages over alternative means of energy storage are discussed. The economic arguments are based on the present or near future capabilities and costs of structural composite materials. The flywheel costs turn out to be considerably higher than for many alternative schemes including advanced batteries, gas turbine generators, and pumped storage schemes. Author (ERA)

N76-32662# Brookhaven National Lab., Upton, N.Y.
COAL CONVERSION TO LIQUID AND GASEOUS HYDROCARBONS IN A CROSS FLOW MOVING BED REACTOR
Vi-Duong Dang and M. Steinberg Oct. 1975 35 p refs Presented at the Natl. Meeting of the Am. Inst. of Chem. Eng., Kansas City, Mo., 11 Apr. 1976
(BNL-20754; Conf-760402-2) Avail: NTIS HC $3.50

A study of coal hydrogenation was performed in a cross flow moving bed reactor. Coal particles moved horizontally in packed form in the reactor while hydrogen moved vertically. Temperature distributions of both gas and solid were obtained by solving the energy equations for packed bed. Weight fractions of carbon, and its gas and liquid products, were obtained by using a three step coal hydrogenation model as a first approximation. The problem was solved numerically for some practical operating conditions of a reactor using a CDC 7600 computer. The effect of several operating parameters on the temperature distribution of the reactor was examined. Increasing the gas residence time decreased the temperature of both solid and gas phases. Increasing the solid phase residence time increased the temperature of both phases. Hydrogen partial pressure did not have any effect on the temperature field. Author (ERA)

N76-32663# Oak Ridge National Lab., Tenn.
APPLICATION OF THE FLUIDIZED BED COAL COMBUSTION SYSTEM TO THE PRODUCTION OF ELECTRIC POWER AND PROCESS HEAT
A. P. Fraas 1976 23 p refs Presented at the Natl. Meeting of the Am. Inst. of Chem. Engin., Kansas City, Mo., 11-14 Apr. 1976 Sponsored by ERDA
(CONF-760402-4) Avail: NTIS HC $3.50

Burning coal with limestone in a fluidized bed offers an intriguing means for burning lignite, high-sulfur coal, anthracite, or organic wastes. This process provides a high heat transfer coefficient and retains the bulk of the sulfur in the bed as CaSO4. Particularly interesting applications under development at ORNL are for a closed cycle gas turbine for total energy systems in building complexes and for the furnace-boiler of a potassium vapor topping cycle for utilities. Both systems also show great promise for use in the process industries as a means of providing both electricity and clean process heat at any temperature up to approximately 820 C. Information developed in the course of recent ORNL work is applied to some proposed industrial applications rquiring both electricity and high-temperature process heat. Author (ERA)

N76-32664# Brookhaven National Lab., Upton, N.Y.
TITANIUM ALLOY HYDRIDES; THEIR PROPERTIES AND APPLICATIONS
J. J. Reilly and J. R. Johnson 1976 24 p refs Presented at the World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA
(BNL-20791; Conf-760304-6) Avail: NTIS HC $3.50

Certain reversible metal hydrides have been proposed as energy storage media. One of these, titanium iron hydride, has already been used in a pilot scale demonstration for this purpose. The formation and properties of other titanium alloy hydrides which are also of interest in this connection are discussed. Particular emphasis will be given to a class of ternary alloys having composition corresponding to TiFe/sub x/M/sub y/, where M is a transition metal. It has been determined that many alloys of this type will react directly and reversibly with hydrogen to form hydrides. The properties of these hydrides vary and are dependent on the particular transition metal substitute and its quantity. The integration of such materials with energy storage systems and their relative advantages are also discussed.
Author (ERA)

N76-32665# Brookhaven National Lab., Upton, N.Y.
BEHAVIOR OF IRON TITANIUM HYDRIDE TEST BEDS: LONG-TERM EFFECTS, HEAT TRANSFER AND MODELING
G. Strickland, J. Milau, and W. S. Yu 1976 31 p refs Presented at the World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA

(BNL-20876; Conf-760304-8) Avail: NTIS HC $4.00

Several types of studies were made with test beds of iron titanium hydride (FeTiH/sub x/) in order to determine their long-term and thermal behavior. This material provides a way of storing hydrogen in relatively dense form at ordinary temperatures and moderate pressures. The data obtained are part of that needed for the design of plant-scale hydride reservoirs. Accelerated cyclic tests were made with 1-in.-diam test beds to determine changes in their long-term behavior, the main result being extensive particle attrition. The thermal behavior of a 6-in.-diam test bed was determined along with the times that various hydrogen flow rates could be sustained during hydriding and dehydriding. Modeling studies were made for the purpose of understanding and characterizing the behvaior of this test bed, and for scaling up the design. A description of each test bed accompanies the data and information obtained from its operation. Author (ERA)

N76-32666# Brookhaven National Lab., Upton, N.Y. Dept. of Applied Science.

HYDROGEN STORAGE VIA IRON: TITANIUM FOR A 26MW(e) PEAKING ELECTRIC PLANT

A. H. Beaufrere, F. J. Salzano, R. J. Isler, and W. S. Yu 1976 21 p refs Presented at the first World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA

(BNL-20902; Conf-760304-5) Avail: NTIS HC $3.50

Work is in progress at the Brookhaven National Laboratory for the development of bulk storage techniques for hydrogen using iron-titanium. The program consists of a variety of activities which include engineering analysis and design of a large bulk hydrogen storage facility, engineering-scale tests, work on the selection and development of suitable iron-titanium alloys, and the construction of a large prototype energy storage system. Based on these engineering studies, a preliminary plant design and cost estimate is presented for a 26 MW(e) hydrogen storage peaking electric power plant, with hydrogen production via water electrolysis, iron-titanium metal hydride hydrogen storage beds and hydrogen-air fuel cells for reconversion to electricity. Cost estimates of a similar plant incorporating advanced technology components are made and compared with allowed costs for such systems. Description of R and D requirements to achieve these goals is discussed. Author (ERA)

N76-32667# California Univ., Livermore. Lawrence Livermore Lab.

ECONOMICS OF INDUSTRIAL PROCESS HEAT FROM SOLAR ENERGY

W. C. Dickinson 18 Feb. 1976 11 p Presented at the ACS Natl. Meeting on Thermochem. Generation of H2, New York, 4 Apr. 1976

(Contract W-7405-eng-48)

(UCRL-77326; Conf-760401-3) Avail: NTIS HC $3.50

The economics of supplying 50% of a company's process heat requirements by solar energy are briefly reviewed. The ERDA-SOHIO industrial process heat project is discussed in more detail. ERA

N76-32668# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

HELIOSTAT ARRAY ANALYSIS. SOLAR POWER ARRAY FOR THE CONCENTRATION OF ENERGY. TECHNICAL REPORT COVERING TASK 4A

T. C. Gurr and M. Riaz Nov. 1975 140 p refs Prepared for Sheldahl, Inc., Northfield, Minn.

(Contract E(11-1)-2699)

(COO-2699-1) Avail: NTIS HC $6.00

Basic physical and theoretical performance characteristics of the heliostat array of a solar-thermal power system were reviewed. The total power redirected towards a central receiver was examined. The objective of this thesis was to analyze the solar flux density distribution at the surface of a central receiver. The analysis was performed upon a vertical cylindrically shaped receiver mounted on a tower located in the center of a horizontal circular ring-shaped mirror field. The angular dimensions of this field are 30 deg and 70 deg the analysis expresses the flux density in a per-unit form and, as such, the actual height of the tower need not be considered until actual power levels are desired. ERA

N76-32669# Mobil Research and Development Corp., Paulsboro, N.J.

DEVELOPMENT STUDIES ON CONVERSION OF METHANOL AND RELATED OXYGENATES TO GASOLINE Quarterly Progress Report, May - Jul. 1975

J. J. Wise Oct. 1975 137 p

(Contract E(49-18)-1773)

(FE-1773-11; QPR-2) Avail: NTIS HC $6.00

This report describes the progress in the development of the methanol-to-gasoline process in the period of May 1 through July 31, 1975. Preliminary aging runs were successfully completed in the fixed bed pilot plant. Based on the results, the catalyst and operating conditions for a long-term catalyst aging run (minimum of 3 months duration) have been selected. The results of car tests with simulated gasoline from methanol have shown that durene concentrations up to 4 wt percent have no significant effects on vehicle performance. Stability tests (i.e., existent and potential gum tests) were made on product gasolines from pilot plant runs. Gasoline products obtained from the initial and middle portions of a cycle have good stability properties. Stability is poor at the point of methanol breakthrough. Considerable progress was made in the engineering design of the 100 B/D pilot unit. Author (ERA)

N76-32670# Boeing Co., Seattle, Wash. Engineering and Construction Div.

GLASS SOLAR HEAT COLLECTOR DEVELOPMENT Final Report

W. D. Beverly, R. B. Gillette, and B. W. Libbey Jan. 1976 164 p refs

(Grant NSF AER-74-09139)

(PB-253150/7; D277-10008-1; NSF/RA-760035) Avail: NTIS HC $6.75 CSCL 13A

Design of a glass vacuum-insulated solar heat collector for heating and cooling of buildings is discussed. Results from this study indicate that glass collectors evacuated to 1/4-Atm can compete on an area basis with conventional nonselective absorber metal collectors; however, to compete with selective absorber collectors, glass collectors must employ either high vacuum or transmitting low emittance films. GRA

N76-32671# Federal Energy Administration, Washington, D.C.

HOME HEATING CONSERVATION ALTERNATIVES AND THE SOLAR COLLECTOR INDUSTRY

Howard Magnus, Richard Stoll, and Howard Walton Mar. 1976 12 p

(PB-253277/8; FEA/B-76/182) Avail: NTIS HC $3.50 CSCL 13A

An analysis of 20-year costs for retrofitting houses with additional insulation and with solar energy systems is presented. Information is provided on the level of manufacturing activities in the solar collector industry. GRA

N76-32672# Franklin Inst. Research Labs., Philadelphia, Pa.

PROCEEDINGS OF THE WORKSHOP ON DRY COOLING SYSTEMS

Alan M. Rubin Jan. 1976 101 p Conf. held at the Franklin Institute Research Labs., Philadelphia, 15-16 Jul. 1975

(Grant NSF ENG-75-18781)

(PB-252754/7; FIRL-F-4202) Avail: NTIS HC $5.50 CSCL 13A

Papers and discussions on current developments in dry cooling systems are reported. The objectives of the workshop were: (1) to identify problem areas, (2) to identify the status of current relevant R and D activities, and (3) to identify future research needs in the area of dry cooling systems. Sixty participants from industry, universities, government, and private research organizations attended the two-day conference. GRA

N76-32673# Stanford Research Inst., Menlo Park, Calif.

RESIDENTIAL HOT WATER SOLAR ENERGY STORAGE SUBSYSTEMS Final Report

Ellis E. Pickering Jan. 1976 118 p refs

(Contract NSF C-905; SRI Proj. 3485)

(PB-252685/3; NSF/RA/N-75-095) Avail: NTIS HC $5.50 CSCL 13A

Low-cost, efficient, and practical hot water solar energy storage subsystems for heating and cooling of residences are

discussed. Both new and innovative vessel materials and configurations are investigated, together with insulation materials. Storage subsystem locations considered include basement, crawl-space, living space, garage, attic, surface exterior and underground exterior. Performance requirements for residential hot water storage systems are investigated. A matrix of advantages and disadvantages is constructed considering vessel material and configuration and location and type of residential construction. Other matters considered are corrosion control, costs, and development requirements. GRA

N76-32674# American Cyanamid Co., Stamford, Conn. Chemical Research Div.
CADMIUM STANNATE SELECTIVE OPTICAL FILMS FOR SOLAR ENERGY APPLICATIONS Annual Report, 1 Jan. - 31 Dec. 1975
G. Haacke and L. C. Burton Jan. 1976 54 p refs Prepared in cooperation with Delaware Univ., Newark.
(Grant NSF AER-73-07957)
(PB-253007/9; NSF/RANN/SE/AER73-07957/PR-75; NSF/RA-760012) Avail: NTIS HC $4.50 CSCL 10B

Progress made during the reporting period has yielded the following results: (1) Cadmium stannate films with 6500/ohm cm conductivity and high optical transmission can be prepared by sputtering; (2) Clear cadmium stannate films with 10 to 20 ohm/square sheet resistance can be spray coated. Sheet resistances as low as 5 ohm/square have been achieved; (3) Junction-free, 1 ohm/square cadmium stannate contacts have been sputtered onto single crystal silicon wafers; and (4) Backwall efficiencies of 5.3% under tungsten illumination (about 6% AMI sunlight) were measured. Author (GRA)

N76-32675# National Bureau of Standards, Washington, D.C. Appliance Labeling Section.
THE DEPARTMENT OF COMMERCE ENERGY LABELING AND ENERGY EFFICIENCY PROGRAMS FOR HOUSEHOLD APPLIANCES Final Report
Bernard J. McGuire, Jr. 18 Dec. 1975 12 p Repr. from Proceedings of Natl. Agr. Outlook Conf., Washington, D.C., 17-20 Nov. 1975 p 369-377
(PB-252773/7) Avail: NTIS HC $3.50 CSCL 10A

The development and present status of the Department of Commerce energy labeling and energy efficiency programs are described. Labels for room air conditioners, combination refrigerator-freezers, and water heaters are discussed in detail. Energy reduction goals under the energy efficiency programs are given. The possible effect of pending legislation is described. GRA

N76-32676# National Conference of State Legislatures, Denver, Colo.
TURNING TOWARD THE SUN. VOLUME 1: ABSTRACTS OF STATE LEGISLATIVE ENACTMENTS OF 1974 AND 1975 REGARDING SOLAR ENERGY
1975 47 p
(Grant NSF ISR-1552)
(PB-252836/2; NSF/RA/G-75-052-Vol-1) Avail: NTIS HC $4.00 CSCL 10A

This report identifies and abstracts all state enactments in 1974 and 1975 that directly relate to improving the prospects for solar energy applications. Specific areas of coverage are property income and sales tax incentives, state financed energy research and development of solar technologies, life-cycled cost analysis, solar provisions in state building codes, access to incident solar energy, and solar energy informational and promotional activities. State financed buildings using solar energy, and selected solar energy publications are also described briefly. GRA

N76-32677# National Science Foundation, Washington, D.C.
SUMMARY OF AWARDS IN ENERGY-RELATED GENERAL RESEARCH Final Report, 1973 - 1975
Jan. 1976 261 p
(PB-252913/9; NSF-75-37) Avail: NTIS HC $9.00 CSCL 10A

An analysis of the National Science Foundation's Research Directorate FY 1975 funding in energy related general research is given. The report includes a listing of FY 1975 energy related workshops and grants. GRA

N76-32678# Princeton Univ., N.J. Center for Environmental Studies.
A STATISTICAL ANALYSIS OF THE MONTHLY CONSUMPTION OF GAS AND ELECTRICITY IN THE HOME
Lawrence S. Mayer and Jeffrey A. Robinson Apr. 1975 116 p
(Grant NSF SIA-72-03516-A02)
(PB-252839/6; NSF/RA/N-75-226) Avail: NTIS HC $5.50 CSCL 10A

The macroconsumption of energy in residential housing as indicated by monthly readings of the gas and electricity meters is examined. The consumption processes for both gas and electricity are shown to have variance trends proportional to the mean trends. A method of estimating the amount of gas saved by a particular unit as a result of the energy crisis is developed. The method uses the concept of degree days and the consumption profile of the unit. GRA

N76-32679# Foster Associates, Inc., Washington, D.C.
ELECTRIC RATE CONCEPTS AND STRUCTURES Final Report
Robert H. Sarikas and Henry Herz May 1976 271 p refs Sponsored by the Bonneville Power Administration, Portland, Oreg.
(Contract DI-14-06-6102N)
(PB-252905/5) Avail: NTIS HC $9.00 CSCL 10A

The report identifies the principle electric rate schedule concepts, examines the social, economic, and/or political policy behind the concept, explores the impact where the concept is implemented, and determines the probable reaction of utility customers to the concepts in terms of retail rate design. The role of utility rate setting and the justification for classes of retail consumers are discussed. Six different cost-based pricing concepts are discussed: (1) average cost pricing; (2) capacity only pricing; (3) energy only pricing; (4) marginal cost and long-run incremental cost and usage; (5) summer-winter differential; and (6) time-of-day pricing. GRA

N76-32680# California Univ., Davis. Inst. of Ecology.
LAND USE, ENERGY FLOW, AND POLICY MAKING IN SOCIETY Final Summary Report
J. W. Young, J. L. Mitchiner, C. Ayers, Y. L. Hunter, and M. A. Pearce 1 Sep. 1975 30 p refs
(Grant NSF GI-27)
(PB-253139/0; NSF/RA/E-75-043) Avail: NTIS HC $4.00 CSCL 10A

Modeling methodology is applied to the simulation of the use of land and energy in society. The computer aids are specifically designed for the evaluation of policy for land and energy use and not for decision making needed to implement policy. GRA

N76-32681# Georgia Inst. of Tech., Atlanta. Coll. of Engineering.
EXPERIMENTAL SOLAR HEAT SUPPLY SYSTEM WITH FIXED MIRROR CONCENTRATORS FOR THE HEATING AND COOLING OF BUILDINGS Technical Report, 1 Jul. 1974 - 30 Jun. 1975
J. Richard Williams and Samuel F. Hutchins, (Scientific Atlanta, Inc., Doraville, Ga.) Jun. 1975 49 p refs
(Grant NSF GI-43936)
(PB-252987/3; NSF/RANN/SE/GI-43936/TR-75-2; NSF/RA/N-75-298) Avail: NTIS HC $4.00 CSCL 10A

A new type of solar collector has been assembled and tested that promises to provide heat at about the same cost as commercially available flat plate collectors, but at a much higher temperature. The higher temperature permits higher COP air conditioning and heat pump operation, with a resulting decrease in the collector area required and lower air conditioning equipment costs as compared with systems using flat plate collectors. GRA

N76-32682# Bureau of Mines, Pittsburgh, Pa. Coal Preparation and Analysis Group.
SULFUR REDUCTION POTENTIAL OF THE COALS OF THE UNITED STATES Report of Investigations, 1967-1975
J. A. Cavallaro, M. T. Johnston (EPA, Pittsburgh), and A. W. Deurbrouck Apr. 1976 334 p refs Supersedes BM-RI-7633 Sponsored by EPA
(PB-252965/9; BM-RI-8118) Avail: NTIS HC $10.00 CSCL 21D

This report presents the results of a washability study of 455 raw coal channel samples with special emphasis on sulfur reduction. These raw coals contained on the average 14.0% ash, 1.91% pyritic sulfur, and 3.02% total sulfur. The complete washability data are presented for each sample processed. A statistical evaluation is included for the coalbeds from which more than 10 samples were collected and for the geographical coal producing regions. A graphical summation is presented for the coal-producing regions and selected coalbeds. Finally, a similar statistical evaluation is included showing composited data interpolated at Btu recovery levels of 50, 60, 70, 80, 90, and 100%. Graphical summations are presented for the various coal-producing regions. Author (GRA)

N76-32683# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
RECOVERY OF HYDROGEN LIQUEFACTION ENERGY Final Report
William R. Parrish 1975 6 p refs Presented at the Conf. on Intersoc. Energy Conversion Eng. (10th), Newark, Del., 18-22 Aug. 1975
(PB-252393/4) Avail: NTIS HC $3.50 CSCL 21D

Ways of recovering part of the liquefaction energy are considered. The emphasis is on utility applications. Results show that it is technically feasible to recover 25 to 50 percent of the actual liquefaction energy if a MHD generator is used; recovery factors of approximately 18 percent could be obtained with gas turbines and lower recovery factors of 8 to 20 percent are possible if fuel cells are used. This energy recovery has the net effect of lowering the required liquefaction energy which makes liquid a more attractive means of storage. GRA

N76-32684# Westinghouse Research Labs., Pittsburgh, Pa.
THIN FILM SOLAR CELLS FOR TERRESTRIAL APPLICATIONS Quarterly Progress Report, 1 Jan. - 31 Mar. 1975
F. A. Shirland, W. J. Biter, E. W. Greeneich, and T. P. Brody 16 May 1975 54 p refs
(Grant NSF AER-74-14918)
(PB-252851/1; NSF/RA/N-75-276; QPR-3) Avail: NTIS HC $4.50 CSCL 10B

The goals of the project are to develop a terrestrial version of the CdS thin film solar cell that is demonstrably amenable to low cost mass production, and to establish data on the lifetime of such cells under the expected conditions of terrestrial use. There were six major tasks for the first year's work. These were: Re-establish the state-of-the-art of making CdS thin film solar cells, but with a terrestrial design cell; Develop a low cost grid system; Develop a method of protecting CdS Solar cells from the atmosphere; Determine the intrinsic lifetime characteristics of cells protected from the environment; Improve the understanding of the principles of operation of the Cu2S-CdS thin film solar cell; Increase cell efficiency and further improve cell design. GRA

N76-32685# Helio Associates, Inc., Tucson, Ariz.
AIR-STABLE SELECTIVE SURFACES FOR SOLAR ENERGY COLLECTORS Final Report, 1 Apr. 1974 - 31 Oct. 1975
A. B. Meinel, D. B. McKenney, and W. T. Beauchamp Oct. 1975 160 p refs
(Grant NSF GI-41895)
(PB-252505/3; NSF/RANN/SE/GI-41895/PR-74-7; NSF/RA/N-75-234) Avail: NTIS HC $6.75 CSCL 10B

The design of highly selective air stable solar absorber coatings is elaborated. Systematic design has been done of absorber designs employing metals and dielectrics for operation at temperatures in excess of 150C. Results of heat stability tests and measurements of the optical properties of the films at temperatures up to 600C are presented. The program demonstrated optical and thermal behavior of interference selective surfaces of the general Ag-Al2O3-Cr-Al2O3 family with cutoff wavelengths ranging from 1.2 to 2.5 micrometers, absorbtances from 0.90 to 0.95, and emittances from 0.02 to 0.04 at operating temperatures. The Helio coatings appear to be highly stable in air at 150C. GRA

N76-32686# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
APPLIED RESEARCH ON II-VI COMPOUND MATERIALS FOR HETEROJUNCTION SOLAR CELLS Quarterly Progress Report, 1 Jul. - 30 Sep. 1975
Richard H. Bube, Alan Fahrenbruch, Julio Aranovich, Fredrik Buch, and Muren Chu Oct. 1975 48 p refs
(Grant NSF AER-75-1679)
(PB-252892/5; NSF/RANN/SE/AER75-1679-75-3; NSF/RA/N-75-280) Avail: NTIS HC $4.00 CSCL 10B

Sufficient data to construct a band diagram for the n-CdSe/p-ZnTe solar cell were obtained. A diffusion potential for the cell of about 1.27 eV was measured suggesting a CdSe electron affinity of about 4.28 eV. A model for the heterojunction is presented in which current transport through interface states is dominant. The bias dependence of the collection efficiency shows that the small hole diffusion length in the CdSe is the principle limitation on the performance of the CdSe/ZnTe cell. Research directed towards producing ohmic contacts to p-CdTe by ion implantation has isolated the effects of each of the preparation steps (pre-etching, ion implantation, and vacuum, Cd, and H2 anneals). GRA

N76-32687# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
APPLIED RESEARCH ON II-VI COMPOUND MATERIALS FOR HETEROJUNCTION SOLAR CELLS Semiannual Progress Report, 1 Jul. - 31 Dec. 1975
Richard H. Bube, Alan Fahrenbruch, Julio Aranovich, Fredrik Buch, Muren Chu, and Kim Mitchell Jan. 1976 60 p refs
(Grant NSF AER-75-1679)
(PB-252893/3; NSF/RANN/SE/AER75-1679-75-4; NSF/RA/N-75-281) Avail: NTIS HC $4.50 CSCL 10B

Control of the CdS vacuum evaporation processes was achieved and films with good optical transmission and a wide range of conductivities were deposited on glass, ITO and CdTe. Controlled doping is done by In co-evaporation. Increasing the density of incorporated In decreases the resistivity (controllable from 0.005 to 10,000 ohm cm), increases the electron mobility, and decreases the optical absorption. The CdS film on crystal CdTe solar cells were made with solar efficiencies between 4.3 and 5.2%. Preliminary CdTe/ZnSe cells grown by CSVT deposition show low quantum efficiencies because of junction alloying at the high substrate temperatures used (about 500C) but high V sub oc were observed. GRA

N76-32688# Itek Corp., Lexington, Mass. Central Research Labs.
EXPLORATION OF UNCONVENTIONAL SOLAR CELLS Final Report
Ralph E. Aldrich and Clark F. Grain 19 Aug. 1975 22 p refs
(Grant NSF AER-74-00928)
(PB-252454/4; NSF/RANN/SE/AER74-00928/PR-75; NSF/RA/N-75-282) Avail: NTIS HC $3.50 CSCL 10B

The objective of this program is to determine the feasibility of using a Schottky barrier on particulate layers of lead oxide as a photovoltaic cell. The oxides of lead are known to efficiently use the wavelength range of the solar spectrum. Major emphasis was placed on an investigation of the I-V characteristics and photovoltaic response of some of the oxides of lead. The oxides studied during the grant period included the tetragonal form of PbO (PbO(T)), Pb3O4 and Pb12O19. Significant progress was made in determining the conditions necessary for good photovoltaic response from emulsion coated layers of these materials. GRA

N76-32689# Maine Univ., Orono. Dept. of Electrical Engineering.
TERNARY COMPOUND THIN FILM SOLAR CELLS Progress Report, 1 Sep. - 30 Nov. 1975
L. L. Kazmerski Dec. 1975 62 p refs
(Grant NSF AER-75-19576)
(PB-252923/8; NSF/RANN/SE/AER75-19576/PR-75; NSF/RA/N-75-232) Avail: NTIS HC $4.50 CSCL 10B

The investigation of ternary compound semiconductors and the development of thin film solar cells using these materials is described. The growth and electrical properties of CuInS2 thin films are described. Two deposition schemes, single and double source methods, are reported. Data are presented indicating the effects of film and substrate temperature on the mobility, resistivity and carrier concentrations of the films. The vacuum deposition

of CuInSe2 thin films is also reported. The temperature dependence of film mobility, conductivity and carrier concentration are presented. The investigation of CuInS2, CuInSe2, and CuInTe2 films by X-ray and electron diffraction is presented. GRA

N76-32690# Southern Methodist Univ., Dallas, Tex.
DEVELOPMENT OF LOW-COST THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS FOR TERRESTRIAL APPLICATIONS Quarterly Progress Report, 1 Jul. - 30 Sep. 1975
Ting L. Chu Oct. 1975 44 p refs Prepared in cooperation with Texas Instruments, Inc., Dallas, Tex.
(Grants NSF AER-73-07843; NSF GI-38981)
(PB-252978/2; NSF/RANN/SE/AER73-07843/PR-75; NSF/RA/N-75-246; QPR-3) Avail: NTIS HC $4.00 CSCL 10B

The recrystallization of silicon on graphite substrates has been continued to further improve the size and uniformity of the crystallites. Silicon solar cells with AMO efficiencies up to 3% have been produced. The deposition and characterization of silicon solar cells on metallurgical-grade silicon substrates have also been carried out. AMO efficiencies up to 4% were obtained for solar cells on cast substrates. Solar cells deposited on Czochralski and zone-refined metallurgical silicon substrates had higher efficiencies. The purification of metallurgical silicon by the zone refining technique has been considered in detail. The floating-zone technique is limited to one zone per pass and does not appear to be economical. Cold wall metal containers and thin wall quartz containers can be used for the horizontal refining of silicon, and the latter appears to be economically viable. GRA

N76-32691# Southern Methodist Univ., Dallas, Tex.
DEVELOPMENT OF LOW COST THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS FOR TERRESTRIAL APPLICATIONS Annual Progress Report, 1 Jan. - 31 Dec. 1975
Ting L. Chu Jan. 1976 87 p refs
(Grants NSF AER-73-07843; NSF GI-38981)
(PB-252979/0; NSF/RANN/SE/AER73-07843/PR-75; NSF/RA/N-75-247) Avail: NTIS HC $5.00 CSCL 10B

The recrystallization of silicon on graphite substrates has been carried out by the unidirectional solidification and zone-melting techniques. Silicon solar cells of 15-25 sq cm area with AMO efficiencies (without anti-reflection coatings) up to 3.7% have been produced. The grain boundary effects in silicon solar cells of the configuration n+/p/cast metallurgical-grade silicon were reduced by increasing the dopant concentration in the p-layer, and AMO efficiencies up to 4% were obtained. Solar cells deposited on Czochralski and floating-zone refined metallurgical silicon substrates had higher efficiencies. Metallurgical silicon has been purified by the chemical treatment of the melt and float-zone refining. The chemical treatment technique appears to be very promising. Although solar cells of higher than 6% AMO efficiency have been produced from metallurgical silicon purified by two floating-zone passes, the floating-zone technique is not economically feasible for the fabrication of low-cost solar cells. GRA

N76-32692# Carnegie-Mellon Univ., Pittsburgh, Pa.
DYNAMIC MODELING AND CONTROL OF SOLAR SEA POWER PLANTS, PART 1
Steven A. Hetyei and Charles P. Neuman 30 Jun. 1975 144 p
(Grants NSF AER-73-07863-A02; NSF GI-39114)
(PB-252983/2; NSF/RANN/SE/GI-39114/PR-75-7; NSF/RA/N-75-270) Avail: NTIS HC $5.50 CSCL 10B

A methodology is developed for modeling the dynamic behavior of solar sea power plant (SSPP) condensers and evaporators. Because of the complexity of a solar sea power plant, dynamic modeling is an essential step prior to the design and construction of a prototype plant. The pertinent physical laws of heat transfer and mass balance are applied to develop lumped parameter, dynamic and steady-state models for single tube condensers and evaporator pre-heaters incorporating falling films. The condenser and pre-heater models are each specified by three ordinary differential equations and one, and two, algebraic equations with time-delay, respectively. GRA

N76-32693# Mobil Research and Development Corp., Paulsboro, N.J.
UPGRADING OF COAL LIQUIDS FOR USE AS POWER GENERATION FUELS, PHASE 1 REPORT
J. G. Bendoraitis, A. V. Cabel, R. B. Callen, T. R. Stein, and S. E. Voltz Jan. 1976 132 p refs
(PB-252939/4; EPRI-361-1) Avail: NTIS HC $6.00 CSCL 21E

The feasibility of using coal liquids for gas turbine fuels was studied. Samples of SRC (Solvent Refined Coal), H-Coal, and Synthoil were investigated. The SRC and H-Coal were prepared from Illinois No. 6 coal (Burning Star Mine), whereas the Synthoil was made from West Virginia coal (Pittsburgh Seam from Ireland Mine). The areas of work included the analytical characterization of coal liquids, their compatibility with selected petroleum fuels, estimation of potential turbine fuel specifications for coal liquids, and some exploratory process studies. The results of this study have shown that the physical properties and chemical compositions of coal liquids need to be improved to meet fuel specifications. GRA

N76-32694# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DESIGN, FABRICATION, AND TEST OF A HELIOSTAT FOR A CENTRAL RECEIVER SOLAR THERMAL POWER PLANT Project Technical Report, May 1974 - Sep. 1975
J. B. Blackmon Sep. 1975 265 p refs Prepared in cooperation with Houston Univ., Tex.
(Grant NSF GI-39456)
(PB-252667/1; MDC-G6043; NSF/RA/N-75-268) Avail: NTIS HC $9.00 CSCL 10B

A full scale central pedestal mounted elevation/azimuth heliostat was designed, fabricated, and tested. The structural support was mounted on a drive housing equipped with a linear actuator for control of the elevation axis, and a harmonic drive for azimuth control. A quadrant photosensor mounted on a separate pedestal and aligned along the target mirror of sight provided error signals to an analog circuit that provided properly apportioned steering commands to the dc motors on the elevation/azimuth movement. Tracking and beam dispersion characteristics were investigated at six typical positions. GRA

N76-32695# Texas Univ., Austin. Center for Energy Studies.
DIRECT AND INDIRECT ECONOMIC, SOCIAL, AND ENVIRONMENTAL IMPACTS OF THE PASSAGE OF THE CALIFORNIA NUCLEAR POWER PLANTS INITIATIVE. VOLUME 1: EXECUTIVE SUMMARY
Martin L. Baughman, Herbert H. Woodson, and Hal B. H. Cooper Apr. 1976 73 p refs 4 Vol.
(Contract FEA-CO-05-60484-00)
(PB-253657/1; FEA/G-76/258-Vol-1) Avail: NTIS HC $4.50 HC also available fron NTIS $26.75/set of 4 reports as PB-253656-SET CSCL 10A

An independent analysis is made of the economic, social, and environmental impacts resulting from the passage or non-passage of the California Nuclear Power Plant initiative. The initiative would place constraints on nuclear power development in California. This executive summary provides a condensed presentation of the results of the study. GRA

N76-32696# Texas Univ., Austin. Center for Energy Studies.
DIRECT AND INDIRECT ECONOMIC, SOCIAL, AND ENVIRONMENTAL IMPACTS OF THE PASSAGE OF THE CALIFORNIA NUCLEAR POWER PLANTS INITIATIVE, VOLUME 2
Martin L. Baughman, Herbert H. Woodson, and Hal B. H. Cooper Apr. 1976 398 p refs 4 Vol.
(Contract FEA-CO-05-60484-00)
(PB-253658/9) Avail: NTIS HC $10.75 HC also available from NTIS $26.75/set of 4 reports as PB-253656-SET CSCL 10A

An analysis was made of the economic, environmental, and sociocultural impacts of alternative electric generation options on California, surrounding states, and the U.S. as a whole. The relative costs, risks, and benefits of passage or nonpassage of the California Nuclear Power Plants Initiative (which would put constraints on nuclear electric generation) were studied. Electricity supply and demand are discussed, including information on capacity requirements, fuels requirements, alternative demand growth patterns, reserves and reliability factors, and supplies of fossil fuels. Electricity price effects, capital-spending patterns,

specific sectoral impacts, employment implications, and long-run economic growth effects of alternative scenarios are covered. Environmental impacts of alternative cases and sociocultural impacts are studied. GRA

N76-32697# Texas Univ., Austin. Center for Energy Studies.
DIRECT AND INDIRECT ECONOMIC, SOCIAL, AND ENVIRONMENTAL IMPACTS OF THE PASSAGE OF THE CALIFORNIA NUCLEAR PLANTS INITIATIVE. VOLUME 3: APPENDICES
Martin L. Baughman, Herbert H. Woodson, and Hal B. H. Cooper Apr. 1976 373 p refs 4 Vol.
(Contract FEA-CO-05-60484-00)
(PB-253659/7) Avail: NTIS HC $10.50 HC also available from NTIS $26.75/set of 4 reports as PB-253656-SET CSCL 10A

The possible economic, environmental, and sociocultural effects were evaluated of the passage or nonpassage of the California Nuclear Power Plants initiative, which would place constraints on nuclear power generation in California. This report is made up of 20 appendixes which contain supplemental information on electricity supply and demand; economic effects; environmental assessment; and sociocultural implications. GRA

N76-32698# Texas Univ., Austin. Center for Energy Studies.
DIRECT AND INDIRECT ECONOMIC, SOCIAL, AND ENVIRONMENTAL IMPACTS OF THE PASSAGE OF THE CALIFORNIA NUCLEAR POWER PLANTS INITIATIVE. VOLUME 4: COMMENTS
Martin L. Baughman, Herbert H. Woodson, and Hal B. H. Cooper Apr. 1976 48 p 4 Vol.
(Contract FEA-CO-05-60484-00)
(PB-253660/5) Avail: NTIS HC $4.00 HC also available from NTIS $26.75/set of 4 reports as PB-253656-SET CSCL 10A

Comments of five members of the Oversight Committee on the accuracy of the analysis are presented. GRA

N76-32699# Brown Univ., Providence, R.I. Dept. of Engineering.
INVESTIGATION OF THIN FILM SOLAR CELLS BASED ON Cu2S AND CERTAIN TERNARY COMPOUNDS Quarterly Progress Report, 1 Jul. - 30 Sep. 1975
J. J. Loferski, ed., A. Wold, J. Shewchun, R. Arnott, E. A. DeMeo, J. Gan, R. Kershaw, E. E. Crisman, R. Beaulieu, H. L. Hwang et al Sep. 1975 35 p refs
(Grant NSF GI-38102)
(PB-252999/8; NSF/RANN/SE/GI-38102X/PR-75-3; NSF/RA/N-75-245) Avail: NTIS HC $4.00 CSCL 10B

A comparison of the properties of the Cu-S layer and of the heterojunction photovoltaic cell resulting from the formation of the copper sulfur compound on CdS single crystal substrates has been initiated. The Cu-S layers have been or will be prepared by: (a) sulfurization of a thin layer of Cu evaporated on the CdS; (b) sulfurization of a thin layer of Cu electroplated on the CdS; (c) a Cu-S layer produced by the chemical substitution of Cu for Cd; (d) a Cu-S layer produced by a solid state reaction between a thin layer of Cu2Cl2 and the CdS and; (e) evaporation of Cu2S onto the CdS. The Cu-S film is characterized by its cathodoluminescence spectrum, its X-ray diffraction pattern, the scanning electron microscope, the electron microprobe and Auger spectroscopy. The current-voltage characteristics and spectral response are monitored. The effects of heat treatment and Cu treatment are also being investigated. GRA

N76-32700# Brown Univ., Providence, R.I. Dept. of Engineering.
INVESTIGATION OF THIN FILM SOLAR CELLS BASED ON Cu2S AND CERTAIN TERNARY COMPOUNDS Semiannual Progress Report, 1 Jan. - 30 Jun. 1975
J. J. Loferski, ed. Jul. 1975 69 p refs
(Grant NSF GI-38102)
(PB-252998/0; NSF/RANN/SE/GI-38102X/PR-75-2; NSF/RA/N-75-244) Avail: NTIS HC $4.50 CSCL 10B

The properties of thin films of chalcocite produced by sulfurization of thin films of evaporated or electroplated Cu on silica, silicon, aluminum and CdS single crystal substrates have been further investigated with the help of scanning electron microscopy in addition to cathodoluminescence and X-ray diffraction analysis. The photovoltaic parameters of heterojunction cells consisting of a sulfurized chalcocite film on CdS single crystal substrates were studied as a function of post-fabrication annealing and Cu-treatments. Such treatments improved the efficiency of such cells, even though it changed the nature of the p-type semiconductor on the CdS crystal. Cells were made by chemical substitution (dipping) on single crystals of the type Cd(x)Zn(1-x)S, CdS(x)Se(1-x) and CdS(x)Te(1-x); no significant difference was observed between these cells and those made on pure CdS crystals. Cells were made by chemical substitution (dipping) on single crystals of the type Cd(x)Zn(1-x)S, CdS(x)Se(1-x) and CdS(x)Te(1-x); no significant difference was observed between these cells and those made on pure CdS crystals. CuinS2 crystals continue to be grown and characterized. GRA

N76-32701# RCA Labs., Princeton, N.J.
EPITAXIAL SILICON TECHNOLOGY FOR LOW-COST SOLAR CELLS Interim Report, 1 Apr. - 31 Jul. 1975
H. Kressel, R. DAiello, P. Robinson, P. M. Raccah (Yeshiva Univ.), F. H. Pollack (Yeshiva Univ.), and S. H. McFarlane Aug. 1975 37 p refs
(Grant NSF AER-74-15532)
(PB-252974/1; PRRL-75-CR-45) Avail: NTIS CSCL 10B

Comparison of cells and diodes made by epitaxial growth and by direct diffusion have shown that the minority-carrier lifetime is generally higher in the epitaxial devices and the saturation current density is lower (by orders of magnitude in some cases). While defect studies are continuing, present evidence shows that the dislocation density is reduced in the epitaxial layer compared with that in the substrate. Furthermore, the data also suggest that the detrimental effects of grain and twin boundaries on the device performance are reduced. The best cells made by epitaxy on EFG substrates have efficiencies of about 9% (compared with 6% by diffusion). However, the cells studied so far are relatively small (0.75 sq cm), and no attempt was made to optimize AR coatings or metallization grids. GRA

N76-32702# RCA Labs., Princeton, N.J.
EPITAXIAL SILICON TECHNOLOGY FOR LOW-COST SOLAR CELLS Interim Report, 1 Nov. 1975 - 30 Jan. 1976
H. Kressel, R. DAiello, E. R. Levin, P. Robinson, P. M. Raccah (Yeshiva Univ.), S. H. McFarlane, and F. H. Pollack (Yeshiva Univ.) Feb. 1976 36 p refs
(Grant NSF AER-74-15532)
(PB-252975/8; PRRL-76-CR-14; NSF/RANN/SE/AER74-15532/PR-75; NSF/RA-760015; IR-3) Avail: NTIS HC $4.00 CSCL 10B

In the third phase of this program the authors have studied the causes of low efficiency in selected diffused and epitaxial solar cells fabricated on EFG ribbon. EBIC mode-scanning electron microscopy combined with a study of electrical characteristics revealed that inclusions (presumed to be SiC)in the EFG ribbon are primary sources of high leakage currents, which seriously reduce cell output. Transient capacitance measurements were begun by studying samples of small-area n(+)/p diodes having both long, approximately 6 micrometers, and short, approximately 0.4 micrometers, lifetimes. In the short-lifetime diodes, two trapping levels were found, at energies of 0.17 and 0.44 eV. GRA

N76-32703# Federal Energy Administration, Washington, D.C.
ENERGY CONSERVATION SITE VISIT REPORT: TOWARD MORE EFFECTIVE ENERGY MANAGEMENT
Apr. 1976 92 p refs Prepared in cooperation with General Services Admin., and Office of Management and Budget
(PB-253279/4; FEA/D-76/002; Paper-38) Avail: NTIS HC $5.00 CSCL 10A

The results of visits to 287 Federal installations to investigate the effectiveness of energy conservation efforts are presented. Although energy use has been reduced significantly further energy conservation is possible in buildings; motor vehicle management; employee transportation systems; and aircraft, ship, and tactical equipment use. In many cases, future energy conservation activities will entail capital investment to improve energy efficiency. Elements of an effective energy conservation program are listed: top management commitment; accountability; formal planning;

monitoring; technical expertise utilized; employee awareness; contingency planning; and resource support. This report is designed to be used as a resource for managers in planning energy conservation procedures and programs. GRA

N76-32704# Transportation Research Board, Washington, D.C.
TRANSPORTATION ENERGY CONSERVATION AND DEMAND
John F. Sacco 1976 77 p refs
(PB-252904/8; TRB/TRR-561; ISBN-0-309-02471-4) Avail: NTIS HC $5.00 CSCL 10A

Contents: impact of the energy shortage on travel patterns and attitudes; evaluation of interaction between rural regional transportation and energy availability; energy savings for work trips-analysis of alternative commuting patterns for New Jersey; gasoline demand by owner characteristics; gasoline use by automobiles; totality indexes for evaluating environmental impacts of highway alternatives. GRA

N76-32705# Federal Energy Administration, Washington, D.C. Office of Trade Resources.
REPORT TO THE CONGRESS ON THE FEASIBILITY OF LOWERING THE PRICE OF US OIL IMPORTS BY PROVIDING INCENTIVES TO DOMESTIC PRODUCER/IMPORTERS
John Treat Mar. 1976 100 p
(PB-253276/0; FEA/M-76/223) Avail: NTIS HC $5.00 CSCL 10A

The feasibility of reducing the price of U.S. oil imports by providing incentives to those domestic oil producers who are also oil importers is assessed. The principal conclusion is that the prospects of a significant reduction of import prices in the near future through new incentive programs are not promising. In the longer term, incentives to expand domestic production and reduce consumption could eventually shrink U.S. import demand and, when added to exploration and development of new world supplies outside the major OPEC countries and reduction of demand in other major consuming countries, could exert downward pressure on OPEC prices. GRA

N76-32706# Solarex Corp., Rockville, Md.
DEVELOPMENT OF AN ECONOMICAL SILICON SOLAR CELL Final Report, 1 Jun. 1974 - 31 Aug. 1975
J. Lindmayer and C. Wrigley Dec. 1975 50 p refs
(Grant NSF GI-43091)
(PB-253384/2; NSF/RA/N-75-303; NSF/RANN/SE/GI-43091/FR-75-1) Avail: NTIS HC $4.00 CSCL 10B

The aim of this project was to investigate a method of growing electronically viable silicon films on inexpensive foreign substrates, with the objective of creating a technology to radically reduce the overall cost of the silicon employed in terrestrial photovoltaic solar energy conversion. The approach employed was to enhance the growth of large silicon crystallites from a restricted nucleation edge by confining arriving silicon atoms to a narrow band traveling across a substrate, i.e., the lateral growth technique (LGT). The efforts employed physical vapor deposition of silicon in a vacuum evaporator and also included subsequent chemical vapor deposition by pyrolysis of silane. Reflection electron diffraction studies of LGT silicon show large crystallization of the films on foreign substrates. GRA

N76-32707# Missouri Univ., Rolla. Dept. of Mechanical Engineering.
EVALUATION OF METHYL ALCOHOL AS A VEHICLE FUEL EXTENDER Final Report
R. T. Johnson and R. K. Riley Aug. 1975 166 p refs
(Contract DOT-OS-40104)
(PB-251108/7; DOT-TST-76-50) Avail: NTIS HC $6.75 CSCL 14B

The behavior of methanol gasoline blends in spark ignition engines, particularly those used in automobiles is characterized. The program included: characterizing octane ratings of methanol gasoline blends, a single cylinder engine study of the effects of engine parameter variations on emissions and fuel economy of methanol gasoline blends and a simulated vehicle program to determine the behavior of the blends for the federal emissions test procedure. Results indicated that no substantial changes in emissions or fuel economy should be expected from operating blends of 10% or less in existing vehicles. Performance, vapor lock, phase separation, and corrosion problems are pointed out. GRA

N76-32708# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
ENERGY SUPPLY, DEMAND/NEED, AND THE GAPS BETWEEN. VOLUME 1: AN OVERVIEW Final Task Report
J. W. Meyer, W. J. Jones, and M. Kessler Mar. 1976 81 p refs Prepared for the M. W. Kellog Co., Houston, Texas
(Contract EPA-68-02-1308)
(PB-251136/8; MIT-EL-75-012-Vol-1; MIT-EL-75-013-Vol-1; EPA-600/2-76-044-a) Avail: NTIS HC $5.00 CSCL 10A

A critical review of selected literature pertaining to energy supply, demand, supply/demand imbalances, and the operational/technological developments needed to redress imbalances is summarized. GRA

N76-32709# Data Resources, Inc., Cambridge, Mass.
THE INTEGRATION OF ENERGY POLICY MODELS Interim Report
Ben Bernanke and Dale W. Jorgenson Jul. 1975 77 p refs
(Grant NSF GI-43097)
(PB-246984/9; NSF/RA/N-75-101) Avail: NTIS HC $5.00 CSCL 21D

This report presents an integrated model for the assessment of alternative U.S. energy policies, based on the inter-industry model and the natural gas model. Also presented is a methodology for integrating energy policy models, which imposes certain consistency requirements on alternative models of the same phenomena. This methodology is applied to the incorporation of exploration and development and wellhead price regulation of natural gas into the integrated energy policy model. Finally presented are four policy simulations with the integrated model. These simulations are the four possible combinations of quotas on oil imports versus no quotas and phased deregulation of the price of natural gas versus no deregulation. GRA

N76-32710# McDonnell-Douglas Research Labs., St. Louis, Mo.
PERFORMANCE CHARACTERISTICS OF A HUELS-TYPE ARC HEATER OPERATING ON HYDROGEN, HELIUM, OR AIR Final Report, 15 Apr. 1974 - 17 Jun. 1975
J. H. Painter and J. F. Schaeffer Mar. 1976 140 p refs
(Contract F40600-74-C-0010)
(AD-A022491; MEDC-TR-76-25) Avail: NTIS CSCL 13/1

The performance characteristics of a scale 0.5 Huels-type arc heater were determined operating on hydrogen, helium, or air. Data were acquired on hydrogen at pressures from 10 to 50 atm, on helium from 25 to 100 atm, and on air from 10 to 100 atm. All three gases were tested at three arc current levels (240, 320, and 400 A) using the same basic arc heater. The hydrogen enthalpies were five to seven times those of air, and the helium enthalpies were 41% to 69% higher than air. Prediction codes for scaling hydrogen and helium arc heaters to larger scale were developed from a similar code for air which was shown to accurately predict the performance of the present AEDC Dust Erosion Tunnel (N = 1.73) arc heater. GRA

N76-32711# ARO, Inc., Arnold Air Force Station, Tenn.
THE DESIGN OF THE 4-MEGAWATT INDUCTION HEATING POWER SUPPLY AT AEDC Final Report, Jan. 1971 - Jul. 1974
J. W. Cunningham AEDC Apr. 1976 101 p refs
(ARO Proj. PW3170; ARO Proj. PF217)
(AD-A023067; ARO-PWT-TR-75-47; AEDC-TR-76-26) Avail: NTIS CSCL 13/1

A large Class C oscillator, which is intended to be a power source for induction heating of gases, has been built. The oscillator uses eight triode vacuum tubes in a push-pull parallel configuration and is capable of a continuous power output of 3.2 MW at frequencies between 10 and 50 kHz. The report describes in detail the design of the oscillator, its auxiliary equipment, and its protective devices. The report is not intended as an operating manual; rather, it is intended to give the reader sufficient information to design experimental hardware which will properly

load the oscillator, and to describe the capabilities and limitations of the oscillator. GRA

N76-32712# Office of Technology Assessment, Washington, D.C.
AN ANALYSIS OF THE ERDA PLAN AND PROGRAM
Oct. 1975 328 p
(PB-250636/8; OTA-E-12) Avail: NTIS HC $10.00 CSCL 10A

This report is an analysis of the energy research and development programs of the Energy Research and Development Administration (ERDA). The analysis was performed primarily by task groups assembled to cover each of ERDA's major programmatic areas: (1) fossil energy; (2) nuclear energy; (3) solar geothermal, and advanced technologies; (4) conservation; and (5) environment and health. Since the ERDA plans reflect the President's view of national energy R and D policy, they will in large measure determine the broader options for our future national energy policy; this assessment is intended to provide the Congress with much of the background information necessary for an effective analysis of the ERDA programs. GRA

N76-32713# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
H2 LIQUEFACTION: EFFECTS OF COMPONENTS EFFICIENCIES Final Report
R. O. Voth and D. E. Daney 1975 9 p refs Proc. of 10th IECEC, Newark, Delaware, 18-22 Aug. 1975, IECEC 1975 Record, p 1356-1362 1975
(PB-252392/6) Avail: NTIS HC $3.50 CSCL 21D

Liquid hydrogen was proposed as a synthetic fuel to be used as an energy carrier to replace fossil fuels in certain applications. The cost of liquid hydrogen is dependent on the cost of gaseous hydrogen plus a cost for liquefaction. The liquefaction costs are a strong function of the efficiency of the hydrogen liquefier. Efficiencies of current large liquefiers are approximately 30 percent of Carnot. An alternate cycle is defined that permits evaluation of overall cycle efficiency. GRA

N76-32714# Westinghouse Research Labs., Pittsburgh, Pa.
THIN FILM SOLAR CELLS FOR TERRESTRIAL APPLICATIONS Quarterly Progress Report, 1 Oct. - 31 Dec. 1975
F. A. Shirland, W. J. Biter, E. W. Greeneich, A. J. Simon, and T. P. Brody 11 Feb. 1976 89 p refs
(Grant NSF AER-74-14918-A01)
(PB-252850/3; NSF/RA-760060; QPR-2) Avail: NTIS HC $5.00 CSCL 10B

Improvements were made in the CdS film deposition process which resulted in a major increase in internal shunt resistance. The low cost dual component grid was more closely specified and is being worked into the standard fabrication process. In cell encapsulation, SiO and Si3N4 have been found to be compatible with the Cu2S layer. An initial trial of 7059 pyrex glass sputtered directly onto the Cu2S barrier layer gave excellent indications for both passivation and encapsulation. A total of 13 months of accelerated life testing of fully encapsulated cells has been completed to date. Indications to date are that very long useful lifetimes - at least on the order of decades - are realizable from encapsulated Cu2S/CdS thin film solar cells. A mathematical analysis of the effect of cell surface topology was extended to include reflections in the interior of the cell leading to an understanding of the contribution of cell structure to overall cell efficiency. GRA

N76-32417 B & K Engineering, Inc., Towson, Md.
APPLICATION OF HEAT PIPES TO DEICING SYSTEMS
Henry J. Suelau, Edward J. Kroliczek, and Charles Philip Brinkman (Dept. of Transportation, Washington, D. C.) *In* ESA Heat Pipes 1976 p 515-527 refs (For availability see N76-32374 23-31)

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N76-32715 Purdue Univ., Lafayette, Ind.
OPTICAL MEASUREMENT OF JET ENGINE EXHAUST POLLUTANT LEVEL Ph.D. Thesis
Fang-pai Chen 1975 140 p
Avail: Univ. Microfilms Order No. 76-20436

Two techniques were developed for the measurement of the total pollutant at a given exhaust cross section. It was shown that, even without a separate measurement of the temperature field, an accuracy within a few percent could be achieved. The possibility of temperature insensitive measurements through an optimized line selection was discussed and illustrated for two existing absorption methods. Also, a multiangular scanning scheme based on a grid of locally homogeneous zones was devised for the retrieval of local concentrations and temperatures. Inversion errors and modelling errors were considered. Reasonable retrieval at the outer annuli could be achieved for a one peaked or two peaked concentration profile. Reducing the number of zones near the center of the grid and using smoothing schemes help suppress oscillatory solutions. Dissert. Abstr.

N76-32716 Washington Univ., Seattle.
A STUDY OF THE INFLUENCE OF AEROSOLS ON URBAN BOUNDARY LAYERS WITH PARTICULAR APPLICATIONS TO THE LOS ANGELES BASIN Ph.D. Thesis
Thomas Peter Ackerman 1976 238 p
Avail: Univ. Microfilms Order No. 76-20702

The effects of pollutants, particularly aerosols, on urban climates were investigated using a boundary layer model. The model utilized a four stream, discrete ordinate method to compute the radiative fluxes in both the visible and the infrared spectrum. Gaseous absorption was treated by fitting empirical absorption coefficients with sums of exponentials. The model is time dependent and treats heat conduction in both the soil and atmosphere. Convective processes were parameterized using transfer coefficients at the ground surface. The rate of inversion rise was also computed in the model. Urban data taken in Los Angeles was used to initialize the model with respect to local meteorological conditions such as advection, and pollutant concentrations. Dissert. Abstr.

N76-32717# California Univ., Livermore. Lawrence Livermore Lab.
DEVELOPMENT AND IMPLEMENTATION OF USER ORIENTED AIR QUALITY MODELS
John J. Walton Feb. 1976 6 p refs Presented at the Conf. on Environmental Modeling and Simulation, Cincinatti, 20-22 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-77273; Conf-760407-2) Avail: NTIS HC $3.50

Implementation of the Air Quality Act and its amendments requires that decisions be made, at various levels of government, on many complex questions, in order to facilitate the work of decision- and policy-makers, readily useable air quality models must be developed. Such models can have quite different requirements and constraints than those developed primarily for research purposes. These needs will be identified and past experience will be drawn upon to illustrate how some of them have or have not been met. ERA

N76-32718# California Univ., Livermore. Lawrence Livermore Lab.
GENERIC SURVEY OF AIR QUALITY SIMULATION MODELS
George D. Sauter 20 Feb. 1976 6 p refs Presented at the Conf. on Environ. Modeling and Simulation, Cincinnati, 20-22 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-77267; Conf-760407-1) Avail: NTIS HC $3.50

This survey of the generic types of models which have been developed for numerical simulation of air quality compares and contrasts them on the basis of such criteria as the simplifying assumptions made in the solution of the general continuity equation, the problems to which each model type is applicable and not applicable, the requirements for input data, and computational speed. Author (ERA)

N76-32719# Pittsburgh Univ., Pa. Dept. of Civil Engineering.
DIFFERENTIAL BED KINETIC ANALYSIS OF HEAVY METAL REMOVALS BY BIOLOGICAL SLIMES Final Report
Ronald D. Neufeld Apr. 1976 129 p refs
(Grant NSF GK-42150)
(PB-252636/6; SETEC-CE-76-008) Avail: NTIS HC $6.00 CSCL 13B

Upflow columnar studies using a captive differential bed of biological sludge were designed to determine the forward and reverse kinetics describing the removal of mercury and cadmium from aqueous solution under experimental conditions when film resistance to mass transfer is negligible. The kinetics of such uptake may be described by the model r=k, (C sup a)-(k sub 2)((Q/A-Q)sup b), where K, K2, A, a,b, are experimentally derived constants, C = liquid phase metal concentration, and Q = metal accumulation on biomass. GRA

N76-32720# Southern Research Inst., Birmingham, Ala.
PROCEEDINGS OF THE WORKSHOP ON SAMPLING, ANALYSIS, AND MONITORING OF STACK EMISSIONS
Charles E. Feazel, ed. Apr. 1976 349 p refs Held at Dallas, Texas, 2-3 Oct. 1975
(PB-252748/9; EPRI-SR-41) Avail: NTIS HC $10.00 CSCL 13B

Equipment and techniques for the continuous monitoring of opacity and gaseous emissions (sulfur dioxide and nitrogen oxides) in stack gas and coal-fired electric power plants were reviewed. The experience of users and problems encountered were discussed. Possible techniques for the continuous measurement of mass particulate emissions that are in the research stage include the attenuation and scattering of light, the deposition of electrical charges, the attenuation of beta radiation, and the effect of deposited particles on the vibrational frequency of a quartz crystal. GRA

N76-32721# North Carolina Univ., Chapel Hill. School of Medicine.
ASSESSMENT OF TOXICITY OF AUTOMOTIVE METALLIC EMISSIONS, VOLUME 1 Final Report
David J. Holbrook, Jr. Research Triangle Park, N. C. EPA Jan. 1976 70 p refs
(Contract EPA-68-02-1205)
(PB-251231/7; EPA-600/1-76-010-a-Vol-1) Avail: NTIS HC $4.50 CSCL 06T

Various parameters of toxicity have been studied for salts of manganese, lead, palladium, and platinum. Acute toxicities (LD-50 doses) are reported for both intraperitoneal injection and oral administration. Concentrations of metallic ions following dietary administration are reported, as are effects on weights of five organs (liver, kidney, spleen, heart, testes). Also following dietary administration, hepatic microsomes were isolated and the following parameters related to in vitro drug metabolism were measured, yield of microsomal protein/g liver, in vitro activities of aniline hydroxylase and aminopyrine demethylase, content of cytochromes P-450 and b5/mg microsomal protein. Development of a rapid and convenient method for the analysis of ribosomal RNA in studies of RNA synthesis is reported. GRA

N76-32722# North Carolina Univ., Chapel Hill. School of Medicine.
ASSESSMENT OF TOXICITY OF AUTOMOTIVE METALLIC EMISSIONS, VOLUME 2 Final Report
David J. Holbrook, Jr. Research Triangle Park, N. C. EPA Jan. 1976 69 p refs
(Contract EPA-68-02-1701)
(PB-251232/5; EPA-600/1-76-010-b-Vol-2) Avail: NTIS HC $4.50 CSCL 06T

Platinum and palladium compounds are currently being used as the active components in the catalytic converters of air pollution control devices on many motor vehicles. It is of interest, therefore, to determine the biological effects of the compounds of these metals. Results of intraperitoneal (IP) administration of PtCl4 or Pd(NO3)2 are reported. Administration at levels of 28 or 56 moles/kg body weight decreased the thymidine incorporation into DNA of spleen, liver, and testis. Effects of various salts of platinum or palladium administered by intraperitoneal injection or ingestion were determined on the parameters of the microsomal mixed function oxidase system from rat liver. Lethal-dose studies are reported following the intraperitoneal or oral administration of salts of lead, manganese, platinum, and palladium to young male rats. GRA

N76-32723# Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
DETECTION OF TRACE PHOSPHORUS IN NATURAL WATERS BY GRAPHITE OVEN FLAME ANALYSIS
Dorothy R. Campbell Feb. 1976 46 p refs
(Contract DI-14-0001-5010)
(PB-252952/7; ERC-0276; W76-07672; OWRT-A-061-GA(1)) Avail: NTIS HC $4.00 CSCL 14B

Phosphorus is analyzed by coupling a graphite furnace to a flame photometer. A sample is added to the furnace where it is dried and vaporized at temperatures which can be as high as 2,800 C. The sample is swept out of the furance by nitrogen mixed with air, and drawn into a hydrogen-air flame. In the flame, POH emission is observed and integrated. The emission is subject to interference from calcium and ferric iron; however, by adding a 'constant matrix' of calcium and EDTA to both samples and standards, it was possible to determine total phosphorus in sewage samples. This method has a detection limit of 3 micrograms/liter phosphorus. The relative standard deviation on repeat measurements of a solution containing 1 mg/liter phosphorus was between 2 and 3%. An analysis, including sample pretreatment, requires less than two minutes. The instrumentation can be used in mobile laboratories for field analyses. GRA

N76-32724# National Bureau of Standards, Washington, D.C.
FLUORESCENCE MEASUREMENTS OF CARCINOGENIC AND POLYCYCLIC AROMATIC HYDROCARBONS IN WATER Final Report
Frederick P. Schwarz and Stanley P. Wasik 1976 7 p refs Presented at the Intern. Conf. on Environ. Sensing and Assessment, Las Vegas, 14-19 Sep. 1975
(PB-252734/9) Avail: NTIS HC $3.50 CSCL 07C

The application of spectrofluorimetry to the measurement and identification of polycyclic aromatic hydrocarbons (PAH) in aqueous solutions was investigated. At naperian absorbances < or = to 0.05, the fluorescence intensities of solutions containing naphthalene, anthracene, pyrene, and fluoranthene in water are a superposition of the component fluorescence spectra. At the higher PAH optical densities of the mg/1 level and when viewed perpendicular to the excitation light, the fluorescence spectra vary unpredictably with the concentration. The PAH fluorescence intensity is unaffected by the presence of sodium chloride at sea water concentrations and by the presence of mg/l concentrations of iron, zinc, cobalt, or nickel cations in the water. GRA

N76-32725# Datagraphics, Inc., Carnegie, Pa.
WATER POLLUTION IN THE CARBON AND ALLOY STEEL INDUSTRIES Final Report, Jun. 1972 - May 1973
Henry C. Bramer and Hugh B. Durham Apr. 1976 277 p
(Grant EPA-S-800625)
(PB-252963/4; EPA-600/2-76-193) Avail: NTIS HC $9.00 CSCL 07A

Information relative to water pollution control practices in the carbon and alloy steel industries is provided. The scope of information includes brief descriptions of the waste-water producing processes, detailed analysis of the raw wasteloads, identification of wastewater treatment methods, cost of treatment methods and an inventory of the steel industry. Coverage of steel industry activities includes coke plant operations, blast furnace systems, sinter plants, steelmaking facilities, various hot forming mills, pickling, cold reduction and plating technology.
Author (GRA)

N76-32726# Washington Univ., Seattle. Dept. of Civil Engineering.
UNIVERSITY OF WASHINGTON ELECTROSTATIC SPRAY SCRUBBER EVALUATION Final Report, Dec. 1974 - Dec. 1975
Michael J. Pilat and Daniel F. Meyer Apr. 1976 76 p refs
(Grant EPA-R-803278)
(PB-252653/1; EPA-600/2-76-100) Avail: NTIS HC $5.00 CSCL 07A

The report gives results of an evaluation of the effectiveness

of a 1,700 cu m/hr (1,000 cfm) portable electrostatic spray scrubber in controlling fine particle emissions. The multiple-pass scrubber, designed, constructed, and tested by the University of Washington, combines oppositely charged aerosol particles and water droplets in two water spray towers. Negatively energized aerosol charging sections (coronas) precede each spray tower. The pilot plant was tested on artificially generated dioctyl phthalate (DOP) aerosol and on emissions from a pulverized coal-fired boiler. The overall mass collection efficiency for the two DOP tests was 24.98% and 99.6%, respectively. The coal-fired boiler emission tests showed a collection efficiency for a 0.5 micron diameter particle ranging from 47.0% to 98.0%. Conditions during the 47.0% test included a low water spray rate. Because of the relatively large inlet size distribution, the overall mass collection efficiency decreased only from 99.58% to 96.09% for the two boiler emission tests. GRA

N76-32727# Radian Corp., Austin, Tex.
ATMOSPHERIC POLLUTION POTENTIAL FROM FOSSIL FUEL RESOURCE EXTRACTION, ON-SITE PROCESSING, AND TRANSPORTATION Final Report, Jan. - Dec. 1975
E. C. Cavanaugh, G. M. Clancy, J. D. Colley, P. S. Dzierlenga, and V. M. Felix Dec. 1975 293 p refs
(Contract EPA-68-02-1319)
(PB-252649/9; EPA-600/2-76-064) Avail: NTIS HC $9.25 CSCL 21D

The processes and operations employed for the production, on-site processing, and transportation of coal, oil, oil shale, and gas are stipulated. Typical processing sequences are represented by modules. For each module, identification and quantification of potential atmospheric emissions is achieved through the use of existing information. A review of emission source monitoring methods, as well as a study of possible source control methods, is presented. Author (GRA)

N76-32728# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical and Environmental Engineering.
INVESTIGATION OF EFFECTIVENESS OF POLYMERS IN THE TREATMENT OF NITROCELLULOSE-MANUFACTURING WASTEWATER Final Report, Jun. 1975 - Mar. 1976
Lawrence K. Wang, Ray W. Shade, William W. Shuster, and Fuson T. Bilgen Mar. 1976 215 p refs
(Contract DAAG53-75-C-0252)
(AD-A023602; RPI-JBA02-1) Avail: NTIS CSCL 07/1

The effectiveness of organic polymers in the treatment of two types of industrial wastewaters has been investigated. The experimental study consisted of initially performing batch jar tests followed by continuous filtration runs with the wastewater, using the results obtained in the jar tests. Six polymers were used in the experiments to determine optimum type and dosage required for effective turbidity removal. Cationic and non-ionic polymers proved to be the most effective in coagulation by the predominant mechanisms of charge neutralization and interparticle bridging, respectively. Bentonite and lime were also used quite effectively as coagulant aids in conjunction with the various polymers. The best method selected for the treatment of wastewater consisted of the addition of 100 mg/l Cat Floc cationic polymer and 100 mg/l of powdered bentonite clay to the wastewater in a batch unit and after sedimentation, filtration of the supernatant at a flow rate of 4 gpm/ sq ft. GRA

N76-32729# GCA Corp., Bedford, Mass.
EVALUATION OF ELECTROSTATIC AUGMENTATION FOR FINE PARTICLE CONTROL Final Report, Oct. 1974 - Oct. 1975
D. W. Cooper and M. T. Rei Mar. 1976 306 p refs
(Contract EPA-68-02-1316)
(PB-253381/8; GCA-TR-75-34-G; EPA-600/2-76-055) Avail: NTIS HC $9.25 CSCL 07A

The report reviews electrostatic augmentation of control devices for fine particulates. The major electrostatic force equations and their evaluation for some reasonable values of particle and collector charge and geometry are presented. The following programs on electrostatic augmentation of filters, scrubbers, and electrostatic precipitators are analyzed: fiber beds used to capture particles electrostatically, dust/fabric electrostatic effects, electric fields applied across filters or generated within filters, a collector using oppositely charged particles and droplets, a charged droplet scrubber, various polarities and configurations for charged droplet scrubbing of charged particles, nuclear radiation used to charge particles for electrostatic precipitation, various configurations and uses for an 'electric curtain,' and improvement of particle-charging in connection with precharging chambers. An electrostatically augmented cyclone and a foam scrubber that uses particle precharging are also considered. GRA

N76-32730# IBM Federal Systems Div., Gaithersburg, Md.
CDHS EXECUTIVE SUMMARY REPORT Final Report
Mar. 1976 36 p
(Contract EPA-68-02-2054)
(PB-253382/6; EPA-450/3-76-011) Avail: NTIS HC $4.00 CSCL 13B

Management of air quality requires constant surveillance of air quality and careful recording of all significant pollution sources. Measurements are required to trace progress of specific emission control attempts and of the general state of air quality. Detailed analysis is required to predict future air pollution conditions and to determine the contributory effect of any specific emission. These considerations must, in turn, be related to Air Pollution Control Implementation Plans to ensure that enforcement actions are achieving desired goals. These and the many unmentioned tasks in air quality control add up to a massive data handling requirement. The CDHS was designed to provide using States (via the EPA Regional Offices) with a universal and compatible system for managing air data. It will also provide an efficient mechnism for timely, complete and accurate input of air quality data to the National Systems. This report contains a brief description of the CDHS system and is intended to provide an executive overview of the system. GRA

N76-32731# Automotive Environmental Systems, Inc., Westminster, Calif.
EVALUATION OF CVS TEST PROCEDURES
Tim Runner Feb. 1976 136 p
(PB-251102/0; ARB-R-4-726-76-42) Avail: NTIS HC $6.00 CSCL 13B

The effect of constant volume sampler test parameters other than temperature on exhaust emissions was determined. Dynamometer inertia weight, road load horsepower, vehicle engine tune adjustments and smoothing the emission test driving schedule parameters were evaluated. Actual vehicle road load horsepower was measured by coast down time and engine manifold vacuum. Tests were performed on 50 1968 through 1975 model year vehicles. 1975 and modified 1972 federal test procedures were used. Observed differences in exhaust emission and fuel economy test results were tested for statistical significance. GRA

N76-32732# Pacific Northwest Environmental Research Lab., Corvallis, Ore.
THE INFLUENCE OF LAND USE ON STREAM NUTRIENT LEVELS Final Report, 1972 - 1974
James M. Omernik Jan. 1976 117 p refs
(PB-251150/9; EPA-600/3-76-014) Avail: NTIS HC $5.50 CSCL 13B

National Eutrophication Survey (NES) data for 473 non-point type drainage areas in the eastern United States were studied for relationships between drainage area characteristics (particularly land use) and nutrient levels in streams. Both the total and inorganic forms of phosphorus and nitrogen concentrations and loads in streams were considered. The objectives were to investigate these relationships, as they were evidenced by the NES data; and develop a means for estimating stream nutrient levels from knowledge of macro drainage area characteristics. GRA

N76-32733# Pacific Northwest Environmental Research Lab., Corvallis, Ore.
ENVIRONMENTAL TRACE MATERIALS: COMPUTER COUPLED RADIOACTIVE ANALYSIS Final Report
Milton H. Feldman, David E. Cawlfield, and Kenneth V. Byram Dec. 1975 44 p refs
(PB-251105/3; EPA-600/3-75-015) Avail: NTIS HC $4.00 CSCL 13B

A neutron activation laboratory with computer coupled equipment and procedures was established. The power of the

methodology for environmental trace material analysis was demonstrated by analyzing various materials and included quality control interlaboratory comparisons. Samples ranged from sewage treatment plant sludges and marine sediments to fresh waters containing very low concentrations of molybdenum, and ores and fertilizers containing cadmium. GRA

N76-32734# Energy Research and Development Administration, Pittsburgh, Pa.
ANALYSIS OF POLYCYCLIC ORGANIC MATERIAL IN COAL, COAL ASH, FLY ASH AND OTHER FUEL AND EMISSION SAMPLES Final Report, Jul. 1974 - Jun. 1975
A. G. Sharkey, J. L. Schultz, C. White, and R. Lett Mar. 1976 31 p ref
(PB-253453/5; EPA-600/2-76-075) Avail: NTIS HC $4.00 CSCL 07A

A high resolution mass spectrometric investigation to determine the major Polynuclear Aromatic Hydrocarbons (PNAs) in samples derived from various fuel conversion processes and related plant emissions is investigated. Studied were particulate materials and extracts of hydrocarbons in the particulate materials collected on filters placed in flue gas streams from coking, smelting, and similar industrial operations. The analysis considered 14 highly carcinogenic PNAs, with nine unique formulas. Additional quantitative data were obtained by low ionizing voltage techniques for major aromatic hydrocarbon classes, where possible. GRA

N76-32735# Ocean Systems, Inc., Reston, Va.
WASTE MANAGEMENT FOR THE COASTAL ZONE: CONCEPTS FOR THE ASSESSMENT OF OCEAN OUTFALLS Final Report
E. F. Gloyna, Neal E. Armstrong, John C. Geyer, M. Lang, and J. D. Parkhurst Mar. 1976 34 p refs
(Contract N00014-67-A-0244-0002)
(AD-A023514) Avail: NTIS CSCL 13/2

In 1973 the Marine Boards assignment was to review coastal wastewater management practices and their environmental impacts. The report considers various waste materials now disposed through ocean outfalls, evaluates several waste disposal systems, and assesses federal regulations governing waste disposal. It deals particularly with the rationale for setting federal standards to protect the marine environment. GRA

N76-32736# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
PATTERN RECOGNITION AND FACTOR ANALYSIS APPLIED TO CHARACTERIZATION OF PARTICULATE COMPOSITION FROM SOUTHWESTERN DESERT ATMOSPHERE
P. D. Gaarenstroom, S. P. Perone, and J. L. Moyers (Arizona Univ., Tucson) Mar. 1976 31 p refs Submitted for publication
(Contract N00014-75-C-0874; Grant NSF MPS-74-12762; NR Proj. 051-552)
(AD-A023235; TR-8) Avail: NTIS CSCL 13/2

Measurements made of the composition of atmospheric particulates collected in the greater Tucson, Arizona, area have been examined using pattern recognition and factor analysis. Cluster analysis showed Si, Ti, Cs, Li, Rb, Al, K, Fe, Ca, Mg, Na, Mn, Sr, Co, and Cr to be primarily of soil origin. Factor analysis separated the variance of the data base into a small number of factors which can reproduce the correlation matrix and can identify other sources of particulates. The source of NH4(+) and SO4(2-) is external to the Tucson area. The remaining species--NO3(-), Zn, Pb, Cu, Ni, and Cd--have several sources. Relative to a remote desert location, Pb in the urban particulates is of the greatest enrichment, followed by the elements of a crustal origin. GRA

N76-32737# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
COMMUNITY NOISE EXPOSURE RESULTING FROM AIRCRAFT OPERATIONS. APPENDIX: NOISEMAP PROGRAM OPERATOR'S MANUAL Final Report
Nicolaas Reddingius Feb. 1976 30 p
(Contract F33615-75-C-5044; AF Proj. 7231)
(AD-A022911; BBN-2946; AMRL-TR-73-108-App) Avail: NTIS CSCL 20/1

This report delineates the program operator changes consistent with the additional developments made on the computer program described in AMRL-TR-73-109 (AD-A004 821). The added capabilities and improved diagnostics that form NOISEMAP 3.2 are discussed. NOISEMAP 3.2 is used Air Force-wide to compute community noise exposure from aircraft flying and ground runup operations for preparing/assessing candidate Environmental Impact Statements and planning compatible land use in the vicinity of air installations. Improvements made to NOISEMAP include: (1) optional outputs in terms of day-night average sound level, noise exposure forecast, and these measures with tone correction and ground runup penalty weightings; (2) optional contour plotting on a line printer when sophisticated contour plotting software and hardware are not available; (3) optional capability to perform the noise exposure computations over limited areas rather than the entire airbase vicinity; (4) computation of the area contained within specified noise exposure contours; (5) variable grid spacing of the computations to provide sufficient data points in high gradient noise exposure regions; and (6) plotting of the aircraft altitude profiles to aid in checking the input operational data. GRA

N76-32738# Harry Diamond Labs., Adelphi, Md.
ANALYSIS OF THE GAS-STACK MONITOR CALIBRATION DATA FOR THE DIAMOND ORDNANCE RADIATION FACILITY
Thomas P. Wright Oct. 1975 18 p ref
(HDL Proj. 290E28)
(AD-A023194; HDL-TM-75-19) Avail: NTIS CSCL 18/4

In order to effectively monitor the release of radioactive argon-41 gas from the DORF site, it is necessary to periodically calibrate the monitoring equipment. This report reviews the analysis of the calibration case. GRA

N76-32350 Virginia Univ., Charlottesville.
PREDICTION OF HIGHWAY NOISE
John K. Haviland *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 189-211 refs (For availability see N76-32339 23-31)

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N76-32739 Purdue Univ., Lafayette, Ind.
NUMERICAL SOLUTIONS OF NON-SELF-ADJOINT EIGENVALUE PROBLEMS ASSOCIATED WITH HEIGHT DEPENDENT EDDY-VISCOSITY AND CONDUCTIVITY MODELS IN STABILITY ANALYSIS FOR ATMOSPHERIC CELLULAR CONVECTION Ph.D. Thesis
Alexander Hamilton Treadway 1975 123 p
Avail: Univ. Microfilms Order No. 76-20493

The non-self-adjoint eigenvalue problem LHT = Ra squared T is investigated where L and H are formally selfadjoint, positive definite, linear differential operators with variable coefficients. T is temperature, R is atmospheric Rayleigh number, and a is a nondimensional wave number. The problem arises in stability analysis for atmospheric cellular convection when the coefficients of eddy-viscosity and conductivity in the Reynolds stress terms in the governing Boussinesq partial differential equations are modeled as prescribed functions depending only on height. Certain aspects of integral equation and spectral theory are used to show that eigenvalues to the problem exist, are real, and are denumerable. Also several eigenfunction expansion results are proved. Dissert. Abstr.

N76-32740 State Univ. of New York, Albany.
NONLINEAR RESONANT INTERACTIONS AMONG EQUATORIAL WAVES Ph.D. Thesis
Alan John Domaracki 1976 99 p
Avail: Univ. Microfilms Order No. 76-19664

The asymptotic method of multiple scales is used to investigate resonant interactions among equatorial waves

described by a divergent equatorial beta plane model. Triads composed of the same as well as different wave types are considered. The special case of second harmonic resonance is also shown to exist for a mixed Rossby gravity wave and for a pair of Rossby waves. The ubiquitous occurrence of resonances in the model is attributed to the meridional structure of equatorial waves which is described by Hermite functions rather than trigonometric functions. The kinematic resonance conditions, which result from an orthogonality condition placed upon nonlinear products, reflect this occurrence by the replacement of the usual meridional wavenumber summation rule with the less restrictive condition that resonances have even symmetry about the equator. Dissert. Abstr.

N76-32741 California Univ., Los Angeles.
ANELASTIC PROCESSES IN STRIKE SLIP FAULTING: APPLICATION TO THE SAN FRANCISCO EARTHQUAKE OF 1906 Ph.D. Thesis
John Belting Rundle 1976 224 p
Avail: Univ. Microfilms Order No. 76-20213

An analytic approximation to the Green's function for the displacements due to a strike slip point source in an elastic layer over a viscoelastic half space is developed. To represent the quasi-static displacements from a large crustal strike slip earthquake, a model is constructed which makes use of the approximate Green's function. Aseismic slip below the brittle seismic zone is also allowed in the model as well as a large scale relative plate velocity. The model is applied to explain the continual changes in geodetic triangulation angles observed during the 40 years following the 1906 San Francisco earthquake. The most important results are that viscoelastic relaxation can explain the data very well, and that the driving force of relative plate motion can be characterized by a horizontal distance scale perpendicular to the plate boundary of hundreds of kilometers. Dissert. Abstr.

N76-32742 Washington Univ., Seattle.
THE BACKWARD HEMISPHERIC SCATTERING RATIO OF ATMOSPHERIC AEROSOLS Ph.D. Thesis
Prem Sagar Bhardwaja 1976 108 p
Avail: Univ. Microfilms Order No. 76-20705

The increase in atmospheric turbidity is due to increased amounts of particulate matter (aerosol) in the atmosphere and the human activities are suspected for such a buildup. Various model calculations have been made to determine the climatic role of atmospheric aerosol. The absorptive and the backward hemispheric scattering properties are among the most important optical parameters that define the role of aerosol in altering the climate on a local and/or regional scale. The backward hemispheric scattering properties of aerosol can be described by a parameter called the backward hemispheric scattering ratio R. It has been shown in this work that the ratio R, calculated on the basis of Mie formulism, for most of the aerosol found in the atmosphere varies linearly with the real part of the refractive index. Dissert. Abstr.

N76-32743 Houston Univ., Tex.
MID-LATITUDE ELECTRON PRECIPITATION INTO THE ATMOSPHERE AND RELATED GEOPHYSICAL PHENOMENA Ph.D. Thesis
Yuan-Chyau Chang 1976 153 p
Avail: Univ. Microfilms Order No. 76-19961

Balloon observations of the X ray flux of photons with energies greater than 25 keV, measured at an atmospheric depth of 8 g/cm and satellite observations of the flux of electrons with energies greater than 35 keV in the dawn sector were analyzed. The substorm associated electron flux during the most disturbed time was estimated to be close to the theoretical upper limit imposed upon the trapped electron flux by the self-sustained cyclotron resonance wave particle interaction. The pitch angle diffusion was found not to be at the strong diffusion limit. The pitch angle distribution was not isotropic. A cross correlation study of the X ray intensities for various energy channels was performed to examine the relative arrival time of electrons with different energies. Dissert. Abstr.

N76-32744 New York Univ., N.Y.
EFFECTS OF A TRANSIENT SEA SURFACE TEMPERATURE ANOMALY ON THE ENERGETICS OF THE MINTZ-ARAKAWA MODEL ATMOSPHERE Ph.D. Thesis
Shu-Hsien Chow 1974 91 p
Avail: Univ. Microfilms Order No. 76-19603

The possible response of the atmosphere, as simulated by the two level global general circulation model, to a transient (one month) North Pacific sea surface temperature anomaly was investigated in terms of the energetics both in the spatial and wave number domains. In the first month, the increased heating, evaporation and condensation over the local anomaly region appeared to cause an increase in the diabatic generation of eddy available potential energy in northern middle latitudes, and the increased temperature gradient, especially on the northern side of the warm pool, was found to increase the eddy conversion of the intermediate scales in northern middle latitudes. In the second month, on the other hand, the removal of the anomalous SST pattern appeared to cause a reduction in eddy activity in northern middle latitudes, with the reduction taking place at all wave numbers. Dissert. Abstr.

N76-32745 Texas A&M Univ., College Station.
ANALYTICAL STUDY OF DISPLACEMENTS ALONG FAULTS WITH IRREGULAR FAULT-PLANE GEOMETRY Ph.D. Thesis
David Williams Barber 1976 65 p
Avail: Univ. Microfilms Order No. 76-20566

The growth of slip along a bend in a fault was analyzed using complex variable techniques of plane elasticity and conformal mapping of the fault plane geometry. The analytical model uses fault displacements to produce bounded stresses at the end regions of slip in accordance with the behavior of previous photoelastic models. The analytical model was applied to faults with maximum angles of bend, relative to fault strike, of 12, 21, and 32 degrees. Although the growth of slip along a bend in a fault is stable (except possibly for small angles of bend where contact-load effects would be negligible), it was concluded that the decrease in resistance caused by slip on the favorably oriented segments permits fault displacements along the entire fault at stress levels much lower than those predicted on the basis of maximum inclination of the fault surface. Dissert. Abstr.

N76-32746*# Control Data Corp., Minneapolis, Minn. Research Div.
COMPARISON OF PERIODIC AND OTHER CHARACTERISTICS OF GEOMAGNETIC AND METEROLOGICAL ROCKET DATA
G. D. Nastrom and A. D. Belmont Aug. 1976 67 p refs
(Contract NAS6-2423)
(NASA-CR-141413) Avail: NTIS HC $4.50 CSCL 05B

The temporal variations in stratospheric winds and temperatures with the geomagnetic field elements were compared. From a periodic analysis of the geomagnetic field elements the amplitude and phase of the quasibiennial, annual, and semiannual waves are given for stations from 1 degree S to 89 degree N. These results are then compared with corresponding waves reported in rocketsonde wind and temperature data. The annual waves are found to be coupled as a result of the annual variation in the dynamo effect of the wind in the lower ionosphere. The semiannual waves are also found to be coupled and three possible causes for the extra tropical stratospheric semiannual wind wave are discussed. Time variance spectra for the interval from 4 days to 44 days in both zonal winds and horizontal geomagnetic field intensity are compared for years when major midwinter warmings occur and years when only minor warmings occur. The noted differences are suggested to arise from upward propagating planetary waves which are absorbed or refracted in varying amounts depending on the prevailing circulation. Author

N76-32747*# Microwave and Electronics Consultants, Atlanta, Ga.
STUDY TO DETERMINE DIELECTRIC PROPERTIES OF SANDSTONE, SHALE, COAL, AND SLATE
Harold L. Bassett and Albert P. Sheppard Sep. 1976 7 p
(Contract NAS8-31852)
(NASA-CR-149991) Avail: NTIS HC $3.50 CSCL 08G

Triplicate dielectric constant and loss tangent measurements on samples of sandstone, shale, coal, and slate were performed. Each of the three necessary configurations of the

coal material was sampled to obtain measurements, with each sample machined parallel to the coal layering orientation. The coal samples were machined perpendicular to the coal layering and measured. They were conditioned at 100% humidity and at room temperature and remeasured; then conditioned in an elevated environment, and remeasured for dielectric properties. The coal data appear to remain relatively constant over the microwave frequency region. At the Ghz frequencies, the relative dielectric constant of coal is slightly higher for the E-field parallel to the layers than for the perpendicular case. S.M.

N76-32748*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE OF LIGHTNING FLASHES HF-UHF: 12 SEPTEMBER 1975, ATLANTA, GEORGIA
David M. Levine, H. H. Jenkins, (Ga. Inst. of Technol.), B. J. Wilson, (Ga. Inst. of Technol.), and C. S. Wilson, (Ga. Inst. of Technol.) Aug. 1976 39 p refs
(NASA-TM-X-71194; X-953-76-176) Avail: NTIS HC $4.00 CSCL 04A

Simultaneous measurement of sferics at 3, 30, 139, and 295 MHz were made during thunderstorms. Wideband electronics and an analogue tape recorder continuously recorded the radiation from lightning with about 300 kHz of bandwidth. The data were obtained during the passage of a cold front. Flashing rate, burst rate and the structure of individual flashes were recorded. The record of a typical flash begins with a sudden burst of closely spaced pulses whose temporal structure is typical of the stepped leader, and ends in a large pulse suggestive of a first return stroke. The remainder of the flash consists of a sequence of pulses of varying amplitude separated by quiet periods of the order of milliseconds. The shape of these pulses and the temporal structure suggest that the first few large pulses are return strokes. Other discharges begin with widely spaced discrete pulses and resemble the preceding discharge less the leader and return stroke phase. The radiation exhibits a similar structure, at each of the frequencies monitored. Author

N76-32749*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EMPIRICAL MODELS OF HIGH LATITUDE ELECTRIC FIELDS
J. P. Heppner Sep. 1976 39 p refs Submitted for publication
(NASA-TM-X-71203; X-625-76-219) Avail: NTIS HC $4.00 CSCL 04A

Model cross sections of the high latitude dawn-dusk electric field based on OGO-6 data are presented for the signature profiles, most frequently encountered for both + and -Y orientations of the interplanetary magnetic field. Line integrals give a total potential of 76 keV in each case. To illustrate extremes, examples of model cross-sections with total potentials of 23 keV and 140 keV are also given. Model convection patterns are also presented utilizing OGO-6 data on boundary locations at other magnetic local times. When this information is combined with characteristic field geometries in the region of the Harang discontinuity, and is supplemented by data from Ba+ cloud motions in the polar cap, it becomes possible to construct realistic convection patterns on the nightside which deviate from the usual sun-aligned patterns. The observational models presented are of limited applicability as a consequence of the variability of observed distributions. These limitations are emphasized with particular attention given to several types of recurrent deviations which have not previously been discussed. Author

N76-32750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PLASMAPAUSE REVISITED
Nelson C. Maynard and Joseph M. Gebowsky Sep. 1976 35 p refs Submitted for publication
(NASA-TM-X-71204; X-625-76-220) Avail: NTIS HC $4.00 CSCL 03B

Saturation of the dc double probe instrument on Explorer 45 was used to identify the plasmapause. A data base was developed to statistically study the average position of the plasmapause over 14.5 hours of magnetic local time under differing magnetic conditions. The afternoon-evening bulge in the L coordinate of the plasmapause versus local time was found centered between 20 and 21 hours MLT during magnetically quiet periods and shifted toward dusk as activity increased, but always post dusk. During quiet periods a bulge in the L coordinate near noon was also seen, which disappeared as activity increased. The average local time distribution plasmapause position during high magnetic activity was irregular in the afternoon region where large scale convection models predict the creation of plasmatails or detached plasma regions from increases in the solar wind induced convection. The results suggest that solar wind induced convection is partially shielded from the dayside. As the intensity of the convection is increased, it more effectively penetrates the dayside, which shifts the post dusk bulge nearer to dusk and eliminates the quiet-time bulge near noon. Author

N76-32751*# Teledyne Industries, Inc., Garland, Tex.
STUDY OF THE CHARACTERISTICS OF SEISMIC SIGNALS GENERATED BY NATURAL AND CULTURAL PHENOMENA
Tom T. Goforth and Robert K. Rasmussen [1974] 71 p refs (Contract NAS1-11889)
(NASA-CR-132606) Avail: NTIS HC $4.50 CSCL 08K

Seismic data recorded at the Tonto Forest Seismological Observatory in Arizona and the Uinta Basin Seismological Observatory in Utah are used to compare the frequency of occurrence, severity, and spectral content of ground motions resulting from earthquakes and other natural and man-made sources with the motions generated by sonic booms. Author

N76-32752# Aerodyne Research, Inc., Bedford, Mass.
AEROSOL ATTENUATION IN THE 2-4 MICROMETERS REGION Final Technical Report, 20 May 1974 - 20 Nov. 1975
Robert C. Sepucha and David M. Mann Mar. 1976 38 p refs
(Contract F30602-74-C-0282; ARPA Order 1279; AF Proj. 1279)
(AD-A023203; ARI-RR-77; RADC-TR-76-52) Avail: NTIS CSCL 04/1

This report describes an experimental facility constructed to measure the extinction and scattering of DF laser radiation by atmospheric aerosols. The details of the apparatus, the theory of the measurements, and calibration results are presented. Author (GRA)

N76-32753# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex. Atmospheric Sciences Lab.
ATMOSPHERIC WATERDROP SIZE DISTRIBUTION AT CAPISTRANO TEST SITE (CTS) FROM 16 APRIL THROUGH 11 MAY 1974. VOLUME 4: TESTS CTS-11 THROUGH CTS-15 Meteorological Data Report
D. H. Dickson, R. B. Loveland, and W. H. Hatch Sep. 1975 303 p
(AD-A022113; ECOM-DR-75-3-Vol-4) Avail: NTIS CSCL 04/1

Atmospheric waterdrop size distribution was measured by a laser fog nephelometer at Capistrano Test Site, California, from 16 April through 11 May 1974. Liquid water content, extinction coefficient, and visibility were calculated from the data obtained. The nephelometer data were collected from sunset to sunrise nightly for 25 consecutive nights. Fog conditions were recorded on four of these nights. A time format of five-minute samples separated by five-minute pauses was used. The data are presented in tabular form. GRA

N76-32754# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex. Atmospheric Sciences Lab.
ATMOSPHERIC WATERDROP SIZE DISTRIBUTION AT CAPISTRANO TEST SITE (CTS) FROM 16 APRIL THROUGH 11 MAY 1974. VOLUME 5: TESTS CTS-16 THROUGH CTS-20 Meteorological Data Report
D. H. Dickson, R. B. Loveland, and W. H. Hatch Sep. 1975 307 p
(AD-A022049; ECOM-DR-75-3-Vol-5) Avail: NTIS CSCL 04/1

For abstract, see N76-32753.

N76-32755# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

ATMOSPHERIC WATERDROP SIZE DISTRIBUTION AT CAPISTRANO TEST SITE (CTS) FROM 16 APRIL THROUGH 11 MAY 1974. VOLUME 6: TEST CTS-21 THROUGH CTS-25 Meteorological Data Report
D. H. Dickson, R. B. Loveland, and W. H. Hatch Sep. 1975 315 p
(AD-A022159; ECOM-DR-75-3-Vol-6) Avail: NTIS CSCL 04/1
For abstract, see N76-32753.

N76-32756# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
DEVELOPMENT OF A PROJECTILE PENETRATION THEORY. REPORT 2: DEEP PENETRATION THEORY FOR HOMOGENEOUS AND LAYERED TARGETS
Robert S. Bernard Feb. 1976 76 p refs
(DA Proj. 4A1-61102-B-52E)
(AD-A022649; WES-TR-S-75-9-2) Avail: NTIS CSCL 19/1
Existing shallow penetration theory (which is based on cavity expansion theory) is modified and extended for application to deep penetration in homogeneous and layered targets. This is accomplished by means of a postulated relation between the target penetration resistance and the so-called 'solid Reynolds number.' The predictions of the modified theory are shown to be in approximate agreement with experimental, empirical, and two-dimensional finite-difference results for shallow as well as deep penetration in metal, rock, concrete, and cohesive soil targets. GRA

N76-32757# Chicago Univ., Ill. Dept. of Geophysical Sciences.
ANALYTICAL SOLUTION OF A MODEL RADIATIVE EQUATION ARISING IN ATMOSPHERIC SOUNDING
Victor Barcilon Mar. 1976 29 p refs
(Contract N00014-76-C-0034; NR Proj. 041-476)
(AD-A023483) Avail: NTIS CSCL 04/2
The problem of inferring the thermal structure of the atmosphere by means of remote sensing is considered within the context of a model transmission function. An analytical solution is derived for a large class of outgoing radiances. The model seems capable of yielding a tropopause. It also yields a formula for the surface temperature. GRA

N76-32758# Colorado State Univ., Fort Collins. Dept. of Earth Resources.
SPECTRAL ESTIMATES OF PLANET ALBEDO AND COMPARISON TO SKYLAB OBSERVATIONS Final Report
David A. Rainey and William E. Marlatt Aug. 1975 22 p refs
(Grant NOAA-03-3-022-85)
(PB-253550/8) Avail: NTIS HC $3.50 CSCL 04A
An application of the adding or doubling method of van de Hulst was made for two homogeneous atmospheric layers composing an inhomogeneous atmosphere. The lower layer was assumed to be an aerosol composed of silicate particles of complex refractive index 1.55-0i corresponding to a wavelength of 0.5 micrometers. The particle size distribution was measured on-site. The upper layer was assumed to be a gaseous layer scattering light in accordance with Rayleigh's phase function. Radiance values were computed for a planetary system composed of the described composite atmospheric layer overlying a Lambert reflecting ground. GRA

N76-32759# Colorado State Univ., Fort Collins. Dept. of Earth Resources.
A COMPARISON OF MODELS FOR COMPUTING ATMOSPHERIC INFRARED TRANSMISSION Final Report
David S. Renne May 1975 157 p refs
(Grant NOAA-03-3-022-85)
(PB-253551/6) Avail: NTIS HC $6.75 CSCL 04A
In 1973 an intensive research effort called SCARP produced a unique set of infrared radiometric data to compare the performance of several atmospheric infrared radiative transfer models. The models were described in detail and were shown to differ primarily in the manner in which the transmissivities for the various gaseous constituents of the atmosphere are computed. The models were compared with observed profiles of apparent surface temperature obtained with airborne radiometers during the SCARP experiment over various test sites in the southern United States. The models were also compared with Skylab infrared spectrometric data. Error and sensitivity analyses showed that the models are quite sensitive to the moisture profile data used as input, and to the selection of surface temperature. In conclusion it was noted that aerosols do not appear to have a significant effect on the computations of infrared transmission in the window region based on SCARP data. GRA

N76-32760# Harry Diamond Labs., Adelphi, Md.
ASYMPTOTIC PROPERTIES OF THE MIE COEFFICIENTS
Dominick A. Giglio Nov. 1975 42 p refs
(DA Proj. 1W6-62616-AH-77; HDL Proj. A77693)
(AD-A023078; HDL-TR-1733) Avail: NTIS CSCL 20/8
Analytic expressions for the asymptotic forms of the Mie coefficients are derived. The asymptotic regions are defined as those where one of the dimensionless parameters x or n is much larger than the other, x being the Mie size parameter and n the coefficient index. The accuracy and range of applicability of the results is investigated and some important special cases are treated in detail. The utility of the results in numerical computations is also discussed. Author (GRA)

N76-32361 City Coll. of the City Univ. of New York.
SEISMIC ANALYSES
Charles A. Miller and Carl J. Costantino *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 347-364 refs (For availability see N76-32339 23-31)

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N76-32761 Texas A&M Univ., College Station.
A SINGLE FIELD OF VIEW METHOD FOR RETRIEVING TROPOSPHERIC TEMPERATURE PROFILES FROM CLOUD-CONTAMINATED RADIANCE DATA Ph.D. Thesis
Donald Bartholomew Hodges 1976 107 p
Avail: Univ. Microfilms Order No. 76-20591
A method to retrieve single field of view (FOV) tropospheric temperature profiles directly from cloud-contaminated radiance data through use of auxiliary data such as observed shelter temperature and estimated cloud top height was presented. It was shown that a well defined temperature profile could be calculated from the radiative transfer equation (RTE) for a partly cloudy atmosphere when the average fractional cloud amount and cloud-top height for the FOV are known. A cloud model was formulated to calculate the fractional cloud amount from an estimated cloud top height. The method was then examined through use of simulated radiance data calculated through vertical integration of the RTE for a partly cloudy atmosphere using known values of cloud top height(s) and fractional cloud amount(s). Temperature profiles were retrieved from the simulated data assuming various errors in the cloud parameters. Dissert. Abstr.

N76-32762*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPENDIUM OF METEOROLOGICAL DATA FOR THE TITAN 3C LAUNCH IN DECEMBER 1973
J. Briscoe Stephens, S. I. Adelfang (Sci. Appl., Inc., Huntsville, Ala.), and A. I. Goldford (Sci. Appl., Inc., Huntsville, Ala.) Aug. 1976 40 p
(NASA-TM-X-73334) Avail: NTIS HC $4.00 CSCL 04B
All the meteorological data for the 19-hour period before the Titan 3 C (AF-777) launch from Kennedy Space Center at 1857 EST on December 13, 1973, are archived at the Marshall Space Flight Center. These data were collected in support of the NASA rocket exhaust effluent prediction and monitoring program. This data set is unique in that soundings were made with a high temporal resolution. All supporting data, such as synoptic charts and surface data, are also included. This is the first in a series of seven data reports. Author

N76-32763*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPENDIUM OF METEOROLOGICAL DATA FOR THE TITAN 3C (AF-777) LAUNCH IN MAY 1975
J. Briscoe Stephens, S. I. Adelfang, and A. I. Goldford Aug. 1976 82 p ref Prepared in cooperation with Sci. Appl., Inc., Huntsville, Ala.
(NASA-TM-X-73338) Avail: NTIS HC $5.00 CSCL 04B

Meteorological data for the 26-hour period prior to launch are recorded. Data were collected in support of the NASA rocket exhaust effluent prediction and monitoring program. Soundings were made approximately every 2 hours from T-14 hours to T-0; therefore, high temporal resolution is provided. All supporting data, such as synoptic charts and wind tower data, are also included. Author

N76-32764# World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING IN METEOROLOGY AND METEOROLOGICAL ASPECTS OF ENVIRONMENTAL PROBLEMS
1975 326 p refs Proc. of the WMO/IAMAP Symp., Caracas, Feb. 1975
(WMO-432; ISBN-92-63-10432-8) Avail: NTIS HC $10.00; WMO, Geneva, Sw. Fr. 50

Following the opening speeches and introductory lecture, papers are presented in the following areas: education and training of class 1 and class 2 personnel; education and training aspects of environmental problems and in the field of cloud physics and weather modification; general problems of meteorological education and training. Statements by participants are included together with summary reports of the session chairmen. For individual titles, see N76-32765 through N76-32803.

N76-32765 World Meteorological Organization, Geneva (Switzerland).
THE ROLE OF THE WMO IN THE FIELD OF METEOROLOGICAL EDUCATION AND TRAINING
A. Nyberg *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 17-24 (For availability see N76-32764 23-47)
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The progress made by the WMO in the field of meteorological education and training, such as preparation and publication of course syllabi and lecture notes, establishment of training centers and the setting up of seminars, is described. ESA

N76-32766 World Meteorological Organization, Geneva (Switzerland).
TRAINING OF CLASS 1 METEOROLOGICAL PERSONNEL AT THE UNIVERSITY OF READING IN COLLABORATION WITH THE UK METEOROLOGICAL OFFICE: A SANDWICH COURSE
R. P. Pearce *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 27-30 (For availability see N76-32764 23-47)
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The structure and content of the sandwich training course in meteorology for class 1 personnel offered by Reading University, England, is described, and its aims and value are discussed. ESA

N76-32767 World Meteorological Organization, Geneva (Switzerland).
THE NATURE AND SCOPE OF CLASS 1 METEOROLOGICAL TRAINING IN THE CARIBBEAN
M. A. Lateef *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 31-33 (For availability see N76-32764 23-47)
Copyright.

Aspects of the class 1 meteorological training program of the University of the West Indies and the Caribbean Meteorological Institute and its content and scope vis-a-vis the WMO guidelines are described. ESA

N76-32768 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING OF CLASS 1 METEOROLOGISTS IN THE WMO TRAINING CENTER IN COSTA RICA
H. Grandoso *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 34-40 (For availability see N76-32764 23-47)
Copyright.

The syllabi, teaching aids and methods of the University of Costa Rica for the education of class 1 meteorological personnel are described. Comments on the program are also given. ESA

N76-32769 World Meteorological Organization, Geneva (Switzerland).
THE DEVELOPMENT OF METEOROLOGICAL TRAINING AT THE UNIVERSITY OF NAIROBI
G. O. P. Obasi *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 41-56 refs (For availability see N76-32764 23-47)
Copyright.

The structure and content of the course programs in meteorology at the University of Nairobi are described. The staffing situation, student population, running costs and development of research facilities are reviewed. ESA

N76-32770 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING OF CLASS 1 PERSONNEL AT THE UNIVERSITY OF BUENOS AIRES
Claudio P. Martinez *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 57-64 (For availability see N76-32764 23-47)
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The establishment and development of training courses of class 1 meteorological personnel at the University of Buenos Aires are outlined. The syllabus and subjects covered by the course are summarized. ESA

N76-32771 World Meteorological Organization, Geneva (Switzerland).
HYDROMETEOROLOGICAL TRAINING AND RESEARCH INSTITUTE ORAN, ALGERIA
M. Tabet-Aoual and J. Lepas *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 65-79 (For availability see N76-32764 23-47)
Copyright.

Following a brief historical review, the facilities, staffing and equipment of the Hydrometeorological Training and Research Institute, Oran, Algeria are reviewed. The training courses for four classes of personnel are outlined together with a description of the training aids. Research activities are summarized. ESA

N76-32772 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING (CLASS 1) AT THE CENTRAL UNIVERSITY OF VENEZUELA, CARACAS
F. AlvarezBernal *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 80-96 (For availability see N76-32764 23-47)
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The main features of the syllabi and curricula in the field of meteorology at the University of Venezuela are outlined. Course content and requirement leading to qualifications in meteorology, hydrology and hydrometeorology are summarized. ESA

N76-32773 World Meteorological Organization, Geneva (Switzerland).
THE GAP BETWEEN THE CONDUCT OF CLASS 2 AND CLASS 1 METEOROLOGISTS TRAINING COURSES
E. V. Chelam *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 99-101 (For availability see N76-32764 23-47)
Copyright.

Certain features of the gap which seems to exist between the responsibilities of various national meteorological services in conducting class 2 training on one hand and class 1 training on the other are pointed out. It is suggested that class 1 training, being primarily professionally oriented, should lie in the hands of the national meteorological service rather than universities,

which should nevertheless offer more academic courses in meteorology. ESA

N76-32774 World Meteorological Organization, Geneva (Switzerland).
TRAINING OF METEOROLOGICAL OFFICERS AT THE EAST AFRICAN INSTITUTE FOR METEOROLOGICAL TRAINING AND RESEARCH
R. Ramanadham *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 102-109 (For availability see N76-32764 23-47)
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The problems encountered in organizing the various professional courses for class 2 personnel (forecasting, agrometeorology, hydrometeorology) and class 4 personnel (meteorological assistants) at the East African Institute for Meteorological Training and Research are reviewed. ESA

N76-32775 World Meteorological Organization, Geneva (Switzerland).
REGIONAL METEOROLOGICAL TRAINING CENTRE, LAGOS, NIGERIA
J. O. Adekoya *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 110-113 (For availability see N76-32764 23-47)
Copyright.

The historical background to the provision of meteorological education and training for class 2 personnel in Nigeria is presented together with details on teaching staff, number of students and improvements for future training activities. ESA

N76-32776 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING OF METEOROLOGICAL PERSONNEL IN CUBA
R. Alvarez *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 114-127 (For availability see N76-32764 23-47)
Copyright.

Following a brief review of the setting up of a national meteorological service, the system of training of the four classes of meteorological personnel is outlined. A description of the structure and content of the courses is given for each class, together with a list of books used. ESA

N76-32777 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING IN METEOROLOGY AT THE VENEZUELAN AIR FORCE TECHNICAL SCHOOL
Tulio Prado *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 128-131 (For availability see N76-32764 23-47)
Copyright.

The system of education and training of class 2 meteorological personnel at the Venezuelan Air Force Technical School is briefly reviewed. The course structure and content are tabulated together with a diagram showing career opportunities. ESA

N76-32778 World Meteorological Organization, Geneva (Switzerland).
TRAINING FOR APPLICATIONS OF METEOROLOGY TO ENVIRONMENTAL PROBLEMS
C. M. Penner *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 135-149 (For availability see N76-32764 23-47)
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The work of the operational meteorologist in fields other than public or aviation weather forecasting is considered together with the training needs of the meteorologists working in meteorological applications to environmental problems. The organization necessary of the provision of meteorological services is outlined, and examples of types of services provided are given. Typical problems on which Canadian meteorologists have been working are described. A summary of training courses for meteorologists is appended. ESA

N76-32779 World Meteorological Organization, Geneva (Switzerland).
ENVIRONMENTAL ASPECTS OF AIR POLLUTION
R. E. Munn and H. Rodhe *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 150-165 refs (For availability see N76-32764 23-47)
Copyright.

The inter-disciplinary nature of the field of air pollution is reviewed, and the role of the meteorologist in the field, for example in the design of tall chimneys, episode control and regional land use planning, is discussed. The education and training of meteorological personnel in air pollution and air pollution personnel per se are examined in terms of functions to be performed. Suggestions regarding associated syllabi are made. Appendices list a job description for a Canadian meteorologist and training course outlines. ESA

N76-32780 World Meteorological Organization, Geneva (Switzerland).
TRAINING OF HYDROMETEOROLOGICAL SPECIALISTS IN THE PROTECTION OF THE ENVIRONMENT
J. P. Doronin *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 166-169 (For availability see N76-32764 23-47)
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The effects man is having on his environment are summarized, and the role the hydrometeorologist should play in protecting the environment by minimizing the dangers is discussed. The aims of lecture courses on environment protection are reviewed and the structure and content of training programs are outlined. ESA

N76-32781 World Meteorological Organization, Geneva (Switzerland).
THE PROTECTION OF THE ENVIRONMENT AND METEOROLOGICAL EDUCATION AND TRAINING
Z. Dobosi *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 170-171 (For availability see N76-32764 23-47)
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The university education of class 1 meteorological personnel is briefly discussed and the need for a comprehensive syllabus for specialization in environment protection is examined. ESA

N76-32782 World Meteorological Organization, Geneva (Switzerland).
SYLLABUS FOR TRAINING IN TECHNIQUES OF MEASUREMENT OF BACKGROUND AIR POLLUTION
Albert Koehler *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 172-177 (For availability see N76-32764 23-47)
Copyright.

An attempt is made to provide a fairly comprehensive list of topics of direct or related concern to air pollution measurement techniques in the ambient air. These include: atmospheric properties related to the generation, distribution and removal of air pollution, factors necessary for the preparation of measurements, sampling, laboratory work, station operation and reporting of data. ESA

N76-32783 National Oceanic and Atmospheric Administration, Washington, D.C.
ENVIRONMENTAL PROBLEMS: REQUIREMENTS FOR INTERDISCIPLINARY TRAINING
L. E. Niemeyer and J. L. Dicke *In* WMO Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 178-184 refs (For availability see N76-32764 23-47)
Copyright.

The various air pollutants and the effect they have on the environment are reviewed. The requirements for the training of meteorologists and associated scientists in the interdisciplinary pollution field are summarized. The courses of the Air Pollution Training Institute are outlined. ESA

N76-32784 World Meteorological Organization, Geneva (Switzerland).
MULTI-DISCIPLINARY TRAINING OF AIR-POLLUTION METEOROLOGISTS
James R. Mahoney *In its* Educ. and Training in Meteorology

and Meteorol. Aspects of Environ. Probl. 1975 p 185-192 refs (For availability see N76-32764 23-47)
Copyright.

The role of meteorology in air pollution control is briefly discussed and the tasks of the air pollution meteorologist are described. The interfaces between meteorology and other specialists in the air pollution field are indicated by a series of questions which might be addressed to meteorologists. Program requirements for the training of air pollution meteorologists are detailed. ESA

N76-32785 World Meteorological Organization, Geneva (Switzerland).
DESIGNING A POSTGRADUATE COURSE ON THE SCIENTIFIC BASIS OF THE PROTECTION OF THE ATMOSPHERIC ENVIRONMENT
F. Baatard *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 193-197 refs (For availability see N76-32764 23-47)
Copyright.

The background to the establishment of a postgraduate course on the scientific basis of the protection of the atmospheric environment is given, followed by a description of the course structure and content. ESA

N76-32786 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING IN WEATHER MODIFICATION
Roland List *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 201-212 refs Sponsored by Atmospheric Environment Serv. of Can. (For availability see N76-32764 23-47)
Copyright.

In view of the increasing interest in weather modification activities there is a need for an adequate education and training program in this field. The components of such a program course are described; these include synoptic aspects, cloud microphysics, cloud dynamics, weather modification theory, design and evaluation of experiments, observational systems, technology of weather modification and other related topics. ESA

N76-32787 World Meteorological Organization, Geneva (Switzerland).
TRAINING SPECIALISTS IN WEATHER MODIFICATION
E. V. Terentev *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 213-214 (For availability see N76-32764 23-47)
Copyright.

The background to the need to establish training courses for specialists in weather modification in the U.S.S.R. is briefly outlined, followed by the duties such a specialist would undertake. The requirements the would-be specialist must meet are noted and a short review is provided of the course structure and content. ESA

N76-32788 World Meteorological Organization, Geneva (Switzerland).
THE ROLES OF UNIVERSITIES AND WEATHER SERVICES IN THE EDUCATION OF METEOROLOGICAL PERSONNEL
Werner A. Baum *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 217-221 (For availability see N76-32764 23-47)
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Following a classification of basic concepts and terminology, the differing roles in the United States of the university, which should produce thoroughly educated scientists, well versed in meteorology as a whole, and the weather services (eg NOAA, Navy, Air Force), which acquaint the graduate with their own policies and practices, are discussed. A review of higher education in the United States is given and some suggestions regarding the relationship between the universities and weather services in the education and training of meteorologists are made. ESA

N76-32789 World Meteorological Organization, Geneva (Switzerland).
TRAINING ACTIVITIES OF THE CENTRAL AMERICAN HYDROMETEOROLOGICAL PROJECT
Eduardo Basso *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 222-228 refs (For availability see N76-32764 23-47)
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The background and objectives of the Central American Hydrometeorological Project (CAHP) are reviewed and the need for appropriate personnel training considered. Meteorological training at the University of Costa Rica is briefly discussed together with the short description of a mobile meteorological training center and general meteorological training in Latin America. The training activities of the CAHP are described; these include local training, fellowships and technical publications. Future plans are briefly given. ESA

N76-32790 World Meteorological Organization, Geneva (Switzerland).
THE IMPACT OF SCIENTIFIC AND TECHNOLOGICAL PROGRESS ON EDUCATION PROGRAMS AND ON THE INITIATION OF YOUNG SCIENTISTS TO SCIENTIFIC RESEARCH
Jacques VanMieghem *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 229-236 refs (For availability see N76-32764 23-47)
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The purpose of a national meteorological service and the role of a university department of meteorology are discussed followed by consideration of the problems raised by the impact of scientific and technological advances on the education and training of meteorological personnel. The qualifications of such personnel are reviewed together with a discussion of the need for refresher courses and training seminars. The initiation of young scientists to research is also considered. ESA

N76-32791 World Meteorological Organization, Geneva (Switzerland).
THE USE OF GATE DATA IN EDUCATION AND TRAINING
R. P. Pearce *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 237-239 (For availability see N76-32764 23-47)
Copyright.

Brief details of the background of the data processing phase of GATE are given followed by a consideration of the main types of data available and their usefulness for meteorological training purposes. ESA

N76-32792 World Meteorological Organization, Geneva (Switzerland).
TRAINING OF HYDROMETEOROLOGICAL PERSONNEL IN THE U.S.S.R.
K. A. Hzmaljan *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 240-244 (For availability see N76-32764 23-47)
Copyright.

The history of hydrometeorological training in the U.S.S.R. is presented followed by a detailed description of the training of meteorological personnel. The material and methodical base of the training scheme is given in addition to the structure and content. ESA

N76-32793 World Meteorological Organization, Geneva (Switzerland).
EDUCATION AND TRAINING OF METEOROLOGICAL PERSONNEL IN SPAIN
Miguel Ballester *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 245-247 (For availability see N76-32764 23-47)
Copyright.

An objective introduction is given to the development of the education and training of meteorologists in Spain by the meteorological service and universities. The specific problem of the scope and targets corresponding to each of the fields of education and training is considered. A proposal is made to establish a Spanish-speaking advisory group to discuss common problems. ESA

N76-32794 World Meteorological Organization, Geneva (Switzerland).

THE IMPORTANCE TO DEVELOPING COUNTRIES OF INTERNATIONAL FELLOWSHIPS FOR TRAINING METEOROLOGICAL PERSONNEL

C. A. Abayomi *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 248-253 (For availability see N76-32764 23-47)

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The effectiveness and efficiency of any meteorological service depends on the quality of its personnel. The need for trained personnel in developing countries is noted and the importance of international fellowships to enable would-be meteorologists to be trained is stressed. A breakdown of fellowships awarded by various UN bodies to the African region is given. ESA

N76-32795 World Meteorological Organization, Geneva (Switzerland).

METEOROLOGICAL TRAINING OF OPERATIONAL PERSONNEL IN THE CARIBBEAN METEOROLOGICAL ORGANIZATION

Geoffrey M. Rudder *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 254-258 (For availability see N76-32764 23-47)

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The provision of training for operational meteorological personnel in the countries surrounding the Caribbean is discussed with attention being paid to the policy and organizational aspects and problems encountered. ESA

N76-32796 World Meteorological Organization, Geneva (Switzerland).

EDUCATION AND TRAINING OF METEOROLOGICAL PERSONNEL IN BRAZIL

Jose LimaFilho *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 259-266 (For availability see N76-32764 23-47)

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The structure and content of the various meteorological training courses in Brazil are outlined together with facilities and teaching staff. ESA

N76-32797 World Meteorological Organization, Geneva (Switzerland).

STUDIES IN ATMOSPHERIC ELECTRICITY

Hans Dolezalek *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 269-273 (For availability see N76-32764 23-47)

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The lack of appreciation of atmospheric electricity by meteorologists is demonstrated and the role it could play in aiding them is discussed. The major disciplines of atmospheric electricity are outlined and certain of them are selected as being suitable for educating meteorologists. ESA

N76-32798 World Meteorological Organization, Geneva (Switzerland).

KELLER PLAN: PERSPECTIVES IN METEOROLOGY

Walter Fernandez *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 274-279 refs (For availability see N76-32764 23-47)

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The principal features of a method of instruction (personalized system of instruction) based on the principles of the psychology of learning are described. Experience gained in applying this method to a course in meteorology at the University of Costa Rica is discussed. ESA

N76-32799 World Meteorological Organization, Geneva (Switzerland).

WEATHER-RELATED DECISION MAKING

Amos Eddy *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 280-282 (For availability see N76-32764 23-47)

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The failure of current meteorological training programs to adequately produce engineering meteorologists who are able to appreciate the value of weather and thus make decisions accordingly is noted. Examples are given of important problem areas in which optimal decision making is required and include the use of land, water, energy and human resources. ESA

N76-32800 World Meteorological Organization, Geneva (Switzerland).

EDUCATION AND TRAINING OF CLASS 1 METEOROLOGICAL PERSONNEL AT THE METEOROLOGICAL INSTITUTE FOR RESEARCH AND TRAINING (MIRT), CAIRO

R. Samy *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 283-287 (For availability see N76-32764 23-47)

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The structure and content of basic, specialized and advanced training programs for class 1 personnel at the Meteorological Institute for Research and Training, Cairo are outlined. Specialization is possible in agricultural and physical meteorology and meteorological instruments. Advanced training includes dynamic meteorology and data processing. Suggestions for compendia of lecture notes are made. ESA

N76-32801 World Meteorological Organization, Geneva (Switzerland).

STUDY PROGRAM FOR A BACHELOR OF SCIENCE DEGREE IN METEOROLOGY AT THE NATIONAL AGRARIAN UNIVERSITY, LIMA, PERU

G. Almeyda *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 288-291 (For availability see N76-32764 23-47)

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The structure and content of the BSc degree in meteorology at the National Agrarian University, Lima, Peru are outlined. ESA

N76-32802 World Meteorological Organization, Geneva (Switzerland).

USE OF OBJECTIVE FITTING TECHNIQUES FOR ANALYSIS AND DIAGNOSIS OF SYNOPTIC SCALE SYSTEMS IN STUDENT LABORATORIES

M. A. Pedder *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 292-295 ref (For availability see N76-32764 23-47)

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Techniques for fitting an orthogonal function surface to meteorological data over large area and to be used as an aid to the analysis of synoptic scale systems in the student practical laboratory are described together with examples. ESA

N76-32803 World Meteorological Organization, Geneva (Switzerland).

THE TEACHING OF AGRICULTURAL METEOROLOGY AND CLIMATOLOGY IN THE TRAINING OF AGRICULTURAL AND FORESTRY ENGINEERS AS A BASIS FOR THE TRAINING OF CLASS 1 AGROMETEOROLOGISTS

Juan J. Burgos *In its* Educ. and Training in Meteorology and Meteorol. Aspects of Environ. Probl. 1975 p 296-303 (For availability see N76-32764 23-47)

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The need for advanced training in agriculture, stock-raising and forestry - sciences connected with soil productivity - is recognized and the application of meteorology reviewed. The concept and definition of the field covered by agricultural meteorology is discussed and the structure and content of courses at university level for agrometeorological education are outlined. ESA

N76-32804# Federal Energy Administration, Washington, D.C. Office of Oil and Gas Analysis.

ANALYSIS OF THE 1974/1975 DECLINE IN PETROLEUM CONSUMPTION

Christopher Alt 9 Mar. 1976 30 p ref

(PB-251957/7; FEA/B-76/184) Avail: NTIS HC $4.00 CSCL 10A

Relative to pre-embargo forecasts, U.S. petroleum product consumption has declined considerably during the last 2 years. A number of factors contributed to the observed decline. This report provides quantitative, empirically-grounded estimates of the separate influences, such as higher prices and adverse macroeconomic changes. The current analysis is based on

simulations using FEA's short-term petroleum forecasting model. GRA

N76-32805# National Climatic Center, Asheville, N.C.
US NAVAL WEATHER SERVICE COMMAND. SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS, REVISED. PACIFIC COAST. VOLUME 5: AREA 30: BAJA, AREA 31: SAN DIEGO 200 SW, AREA 32: SAN DIEGO, AREA 33: SANTA ROSA ISLAND SW, AREA 34: POINT MUGU NW, AREA 35: SAN FRANCISCO
May 1976 486 p Revised
(AD-A022575) Avail: NTIS CSCL 04/2

The report presents marine climatological data for specific coastal areas in 21 different tables including weather occurrence, wind direction and speed, cloud amount, ceiling height, visibility, precipitation, dry bulb, relative humidity, air-sea temperature difference, sea height and period, sea surface temperature and sea level pressure. GRA

N76-32806# National Climatic Center, Asheville, N.C.
US NAVAL WEATHER SERVICE COMMAND. SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS, REVISED. PACIFIC COAST. VOLUME 6: AREA 36: EUREKA, AREA 38: CAPE BLANCO, AREA 39: NEWPORT, AREA 40: ASTORIA, AREA 41: VANCOVER ISLAND SW
May 1976 486 p Revised
(AD-A022578) Avail: NTIS CSCL 04/2

For abstract, see preceding accession.

N76-32807# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
DIURNAL VARIATION OF OCEANIC DEEP CUMULUS CONVECTION. PAPER 1: OBSERVATIONAL EVIDENCE. PAPER 2: PHYSICAL HYPOTHESIS
Robert W. Jacobson, Jr. and William M. Gray Feb. 1976 115 p refs
(Grant NOAA-04-3-158-51)
(PB-253704/1; AS-Paper-243; NOAA-76032203; ISSN-0067-0340) Avail: NTIS HC $5.50 CSCL 04B

Two papers on the diurnal variability of oceanic deep cumulus convection are presented. The first paper presents observational evidence in support of the exixtence of a significant morning maximum and afternoon-evening minimum of oceanic deep convection. The second paper advances a physical hypothesis for this diurnal variation. This hypothesis is based on day vs. night differences in cloud region and surrounding cloud free region radiational cooling. GRA

N76-32808# Hawaii Univ., Honolulu.
WIND ENGINEERING RESEARCH DIGEST, VOLUME 2
Arthur N. L. Chiu 1975 113 p refs Prepared in cooperation with the Wind Engineering Research Council
(Grant NSF GK-38047)
(PB-252838/8) Avail: NTIS HC $5.50 CSCL 04B

A partial listing of the contents includes: Structure of wind; wind wave effects; effects on urban areas; wind loading on structures; design for hurricanes and tornadoes; environmental factors; legal factors; special problems; wind considerations in urban planning; building codes and regulations; socioeconomic effects; and wind energy. GRA

N76-32809# National Marine Fisheries Service, Seattle, Wash.
LARGE-SCALE AIR-SEA INTERACTIONS AT OCEAN WEATHER STATION 5, 1951 - 1971
David M. Husby and Gunter R. Seckel Nov. 1975 53 p
(PB-253560/7; NOAA-TR-NMFS-SSRF-696; NOAA-76031603) Avail: NTIS HC $4.50 CSCL 04B

The meteorological observations at OWS-V (Ocean Weather Station V, lat. 34 degrees N, long. 164 degrees E) were used to compute large scale air/sea heat exchange processes and wind stresses for each month from September 1951 to March 1971. The monthly values are tabulated as anomalies from the 1955 to 1971 means. The quality of the data record and the accuracy of the derived heat exchange components are discussed. The air/sea interaction climatology at OWS-V, which lies in the net annual heat loss area of the western North Pacific, is described. GRA

N76-32810# Pennsylvania State Univ., University Park. Dept. of Meteorology.
TEMPERATURE GRADIENTS AND CLEAR-AIR TURBULENCE PROBABILITIES Final Report
Morris A. Bender and Hans Danofsky Feb. 1976 37 p refs (Grant NOAA-04-3-158-60)
(PB-253533/4; NOAA-76030404) Avail: NTIS HC $4.00 CSCL 04A

A 747 aircraft with special instrumentation was used for the study of clear air turbulence (CAT). The observations were compared with satellite derived radiance gradients, conventional temperature gradients from analyzed maps, and temperature gradients obtained from the thermometer on the plane. The results led to some of the following conclusions: (1) In regions of weak gradients of temperature or of CO2-band radiance, probability of CAT is extremely small; (2) CAT probabilities are significantly higher over mountains than flat terrain; and (3) Even over mountains, the probability of CAT is greatly increased by large gradients of temperature or radiance. Author (GRA)

N76-32811# National Weather Service, Fort Worth, Tex.
OBJECTIVE FORECASTING OF PAN EVAPORATION, TWO CONTRIBUTIONS
Nicholas P. Cimino (WSFO, Oklahoma City) and Johnnie B. Graham (WSFO, Lubbock, Texas) Mar. 1976 18 p refs
(PB-253525/0; NOAA-TM-NWS-SR-85; NOAA-76031606) Avail: NTIS HC $3.50 CSCL 04B

Two articles on forecasting of pan evaporation are reported. The first, an aid to agricultural evaporation forecasting, offers a linear equation which estimates 24 hour pan evaporation as a function of means of temperature, relative humidity and 20 foot winds. The second article, An Objective Method of Forecasting Total Open-Pan Evaporation for a 48 Hour Period on the Texas South Plains, Using Some Parameters from the FOUS68 Message, introduces an equation thought to produce meaningful forecasts of 48 hour open-pan evaporation observed at the Texas A and M Research and Extension Center at Lubbock, Texas. GRA

N76-32812# Illinois State Water Survey, Urbana.
DESIGN OF AN EXPERIMENT TO SUPPRESS HAIL IN ILLINOIS Final Report
Stanley A. Changnon, Jr. and Griffith M. Morgan, Jr. 1976 201 p refs
(Grants NSF GI-37859; NSF ERT-73-07770)
(PB-253446/9; ISWS/B-61/76; W76-08330) Avail: NTIS HC $7.75 CSCL 04B

An optimum design is presented for a hail suppression experiment in Illinois. The design was based on 9 years of hail research geared to hail modification planning. Studies of 3 cm and 10 cm radars, surface hail measurements, weather analysis and objective forecasting techniques, aircraft measurements of cloud properties, seeding technologies, and evaluation techniques were reviewed in detail. The hail suppression experiment design included the modification hypothesis and related seeding technologies, the statistical-physical design and evaluation, operational requirements, and impact monitoring and public interaction efforts. The advisability of conducting such an experiment at this time was discussed. GRA

N76-32813# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF SPATIAL DISCRETIZATION ON THE STEADY-STATE AND TRANSIENT SOLUTIONS OF A DISPERSIVE WAVE EQUATION Final Report, Jan. - Mar. 1976
Arthur L. Schoenstadt Mar. 1976 38 p refs
(AD-A023083; NPS-53Z76036) Avail: NTIS CSCL 12/1

The study of the dispersive wave equation is fundamental to an understanding of the process of geostrophic adjustment. In this report, the effect of replacing the spatial derivatives in a dispersive wave equation with second order, centered finite differences is examined with the use of Fourier Transform methods. The discretization is shown to both decrease the rate of spatial decay of the steady state solution, and to introduce additional transients at least as persistent as those in the differential case. Author (GRA)

N76-32814# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 14815 LANCE, MISSILE NO. 2620, ROUND NO. 272 APT (19 NOVEMBER 1975) Meteorological Data Report
Nov. 1975 20 p
(DA Proj. 1T6-65702-D-127)
(AD-A022776; DR-901) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 14815 Lance, Missile Number 2620, Round Number 272 APT, are presented in tabular form. Author (GRA)

N76-32815# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 17901A HONEST JOHN, MISSILE NO. 348, ROUND NO. 649 ASL (25 NOVEMBER 1975) Meteorological Data Report
Nov. 1975 18 p
(DA Proj. 1T6-65702-D-127)
(AD-A022777; DR-904) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 17901A Honest John, Missile Number 348, Round Number 649 ASL, are presented in tabular form. Author (GRA)

N76-32816# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12812B LANCE MISSILE NO. 2152, ROUND NO. 273 ECL (12 FEBRUARY 1975) Meteorological Data Report
Feb. 1976 26 p
(DA Proj. 1T6-65702-D-127)
(AD-A022838; DR-907) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 12812B Lance, Missile Number 2152, Round Number 273 ECL, are presented in tabular form. GRA

N76-32817# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 17901A HONEST JOHN, MISSILE NO. 347, ROUND NO. 648 ASL (25 NOVEMBER 1975) Meteorological Data Report
Nov. 1975 18 p
(DA Proj. 1T6-65702-D-127)
(AD-A022778; DR-903) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 17901A Honest John, Missile Number 347, Round Number 648 ASL, are presented in tabular form. Author (GRA)

N76-32818# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 17901A HONEST JOHN MISSILE NO. 345, ROUND NO. 647 ASL
Nov. 1975 25 p
(DA Proj. 1T6-65702-D-127)
(AD-A022835; DR-902) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 17901A Honest John, Missile Number 345, Round Number 647 ASL, are presented in tabular form. Author (GRA)

N76-32819# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 03702A HONEST JOHN MISSLE NO. 1524, ROUND NO. 650 AML (2 DECEMBER 1975) Meteorological Data Report
Dec. 1975 20 p
(DA Proj. 1T6-65702-D-127)
(AD-A022836; DR-905) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 03702A Honest John, Missile Number 1524, Round Number 650 AML, are presented in tabular form. Author (GRA)

N76-32820# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12814C LANCE, MISSILE NO. 2435, ROUND NO. 269 RST (11 NOVEMBER 1975) Meteorological Data Report
Nov. 1975 37 p
(DA Proj. 1T6-65702-D-127)
(AD-A022775; DR-897) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 12814C Lance, Missile Number 2435, Round Number 269 RST, are presented in tabular form. Author (GRA)

N76-32821# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 15002A LITTLE JOHN, MISSILE NO. 1934, ROUND NO. 721 RG (11 FEBRUARY 1976) Meteorological Data Report
Feb. 1976 25 p
(DA Proj. 1T6-65702-D-127)
(AD-A022781; DR-906) Avail: NTIS CSCL 04/2
Meteorological data gathered for the launching of 15002A Little John, Missile Number 1934, Round Number 721 RG, are presented in tabular form. Author (GRA)

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

No abstracts in this category.

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N76-32822 Purdue Univ., Lafayette, Ind.
A MATHEMATICAL THEORY OF GROWTH PROCESSES AND MECHANICAL BEHAVIOR OF BIOLOGICAL MATERIALS Ph.D. Thesis
Prakash Hore 1975 150 p
Avail: Univ. Microfilms Order No. 76-20450
The fundamental relations for field and constitutive equations were developed for a growing biomaterial which is composed of different species. Various concepts in continuum mechanics, thermodynamics, and biochemical kinetics were used. A mathematical formalism was presented, and focused on the behavior of general viscoelastic materials with applications to such problems as the influence of stresses, concentration, and temperature fields on the growth of biosolids, e.g., growth of bones, and the chemotherapeutic treatment of a tumor. Extension was also indicated to the case of biofluids, with applications to such problems as the control of abnormal growth of cellular constituents in a fluid, e.g., chemotherapy of leukemia.
Dissert. Abstr.

N76-32823# Canada Inst. for Scientific and Technical Information, Ottawa (Ontario).
THE SILICON COMPONENT IN LIVING CELLS AND ORGANISMS
W. Sedlak 1976 14 p refs Transl. into ENGLISH from Kosmos. Ser. A (Warsaw), v. 12, no. 6, 1963 p 497-504
(NRC/CNR-TT-1879; ISSN-0077-5606) Avail: NTIS HC $3.50
Biological aspects of silicon are discussed. Silicosis and the silico-arthritic syndrome of Caplan are discussed along with the silicon content of the blood, brain, and skin. It is suggested that the primeval life was based on silicon compounds. Later, carbon supplanted the silicon. F.O.S.

N76-32824*# Hardin-Simmons Univ., Abilene, Tex. Science Research Center.
RESPONSE OF SELECTED MICROORGANISMS TO EXPERIMENTAL PLANETARY ENVIRONMENTS Semiannual Progress Report, 1 Jan. - 30 Jun. 1976
Terry L. Foster and Luther Winans, Jr. Aug. 1976 37 p
(Grant NGR-44-095-001)
(NASA-CR-148833; SAPR-8) Avail: NTIS HC $4.00 CSCL 06M
Results are presented on the anaerobic conversion of phosphite to phosphate. It is demonstrated that in the presence of both phosphite and hypophosphite, the phosphite is the

preferred phosphorous source. An investigation in which P-32 labeled hypophosphite was added to the basal medium demonstrates that the labeled hypophosphite was incorporated into the metabolic reactions of the cell. Other data show that as cell growth occurs, the phosphite and/or hypophosphite levels decrease. The Bacillus sp. capable of anaerobic utilization of phosphite was isolated from Cape Canaveral soil samples, and it is partially characterized. Also included are continued investigations of omnitherms. The data presented show that some of these possess significant resistance to the Viking dry-heat cycle, and that they retain their omnithermic characteristic after recovery from the heat cycle. Other physiological characteristics of these isolates are also presented. It is demonstrated that omnitherms can be isolated from Cape Canaveral soil. Author

N76-32825*# Transemantics, Inc., Washington, D.C.
PLANT GROWTH AND DEVELOPMENT UNDER CONDITIONS SIMULATING WEIGHTLESSNESS
A. I. Merkis, R. S. Laurinavichyus, O. Yu. Rupaynene, and E. K. Savichene Sep. 1976 11 p refs Transl. into ENGLISH from Doklady Akademii Nauk SSSR (USSR), vol. 226, no. 4, Feb. 1976 p 978-981
(Contract NASw-2792)
(NASA-TT-F-17214) Avail: NTIS HC $3.50 CSCL 06C

The effect of weightlessness on growth and development was studied in Arabidopsis thaliana (L.) Heynh and Chenopodium rubrum L. The plants were grown in a sterile tube culture on an agar nutrient medium. They were grown in the center of a clinostat, the rotation period of which was 21 sec. The force of gravity for the plants more remote from the center did not exceed 6.8 .00001g. Twenty-four-hour illumination was provided. The Arabidopsis thaliana completed the entire growth cycle in 35 - 37 days, and the Chenopodium rubrum - in 100 - 110 days. The results show that weightlessness did not affect significantly the seed germination. A noticeable deviation was root growth orientation: one part of the roots grew deeper into the nutrient medium, while the other crept along the agar surface. As the growing process progressed, the effect of weightlessness became more pronounced. Results also indicate that plant growth and morphogenesis were disturbed during weightlessness in the later stages of their development. Author

N76-32826# Texas Univ., San Antonio.
GROWTH AND DEVELOPMENT OF NEONATAL MICE EXPOSED TO HIGH-FREQUENCY ELECTROMAGNETIC FIELDS Final Report, Feb. 1974 - Feb. 1975
William B. Stavinoha, Arvin Modak, Miguel A. Medina, and Arthur E. Gass Dec. 1975 12 p refs
(Contract F41609-74-C-0018; AF Proj. 7757)
(AD-A022765; SAM-TR-75-51) Avail: NTIS CSCL 06/18

Four-day-old mice were exposed to high-frequency electromagnetic radiation. Growth rate was followed for up to 16 weeks of age. No effect of irradiation on the growth and development of these neonatal mice was evident. GRA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N76-32827# Witwatersrand Univ., Johannesburg (South Africa). School of Mechanical Engineering.
MEASUREMENTS OF THE TEMPERATURE PROFILES IN THE FOREARM SKIN OF A NUDE RESTING SUBJECT EXPOSED TO A RANGE OF THERMALLY NEUTRAL ENVIRONMENTS
A. M. Patterson Mar. 1976 86 p refs
(ISBN-0-85494-371-4; Rept-66) Avail: NTIS HC $5.00

Reliable measurements of temperature profiles in the first 2 to 3 mm depth of skin are obtained on the forearm of a nude subject at rest in environments ranging from 24 C to 34 C dry bulk temperature. Resolutions in temperature and depth were typically 0.02 K and 0.04 mm and great care was taken to avoid transient effects. The profiles obtained have a dog-leg appearance with a sharp change in gradient at about 1 mm depth. The change in slope represents either a change in heat flux, or thermal conductivity, or both, and is a feature of a model of the thermal role of blood flow in skin to be published. Author

N76-32828# Army Aeromedical Research Lab., Fort Rucker, Ala.
STUDIES OF VISUAL DISORIENTATION. 1: PERCEIVED STABILITY OF THE VISUAL WORLD DURING SACCADIC EYE MOVEMENTS
Franklin F. Holly 16 Apr. 1976 7 p Presented at Southern Soc. for Philosophy and Psychol., Atlanta, 16 Apr. 1976
(AD-A023599) Avail: NTIS CSCL 05/10

It is shown that the most commonly accepted version of the extraretinal signal leads to a paradox. A possible resolution of this paradox is presented. It was also found that a moving stimulus which is present for a portion of a saccade and which moves at approximately the same velocity as the eyes will, in most cases, not produce any disorientation. However, it will lead to an erroneous perception of that stimulus. GRA

N76-32829# Presbyterian-Pennsylvania Univ. Medical Center, Philadelphia.
BIOCHEMICAL CHANGES IN NAVAL AIRCREWMEN CAUSED BY STRESS IN FLIGHT PERFORMANCE Progress Report
B. F. Burgess May 1973 7 p
(Contract N62269-73-C-0571)
(AD-A020277) Avail: NTIS CSCL 06/1

The pilot study indicates that the excretion of o-hydroxy hippuric acid in urine is a useful addendum to the molecular determinants of stress and, under controlled conditions, may aid in identifying candidates who can or cannot succeed as test parachutists. In concurrent experiments all parachutists studied showed a significant increase in plasma phosphatidyl glycerol, a sensitive and proven indicator for stress. Further studies have shown that the distribution of cyclic AMP in living tissues is ubiquitous and that increased tissue levels are associated with beta adrenergic reactions. It was postulated that changes in tissue cyclic AMP levels might be correlated with physiological changes resulting from the application of whole body stresses, and that tissue cycle AMP could be used as an indicator of physiological stress. GRA

N76-32830# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE PRESSURE AND PULSE RATE AS INDICES OF CARDIAC OUTPUT
Y. Asawa 6 Jan. 1976 20 p refs Transl. into ENGLISH from Japan. J. Anesthesiology (Japan), v. 18, 1969 p 1115-1123
(AD-A020460; FTD-ID(RS)I-2417-75) Avail: NTIS CSCL 06/5

If cardiac output could not be measured directly, it might be inferred from vital signs readily obtained clinically. The present study is an attempt to see whether such an estimation is possible. The Cardiac output per minute (C. o(m)) is obtained by Stroke volume (ml) X Heart rate (per minute). The heart rate could be obtained readily. Thus if the variation of Stroke volume (s.v.) could be estimated, then the variation of cardiac output per minute (C. o(m)) will be estimated. While exact statements cannot be made on the changes in stroke volume unless one knows the extensibility and calibre of the blood vessel, one can obtain the expected change of stroke volume from the age-specific degree of vascular extensibility derived statistically. GRA

N76-32831# Dayton Univ. Research Inst., Ohio.
BONE STRENGTH AND IN-FLIGHT MECHANICAL STRESSES Final Scientific Report
G. A. Graves, P. K. Bajpai, D. E. McCullum, and H. G. Stein 29 Aug. 1975 269 p refs
(Contract F44620-71-C-0083; AF Proj. 9777)
(AD-A020531; AFOSR-76-0039TR) Avail: NTIS CSCL 06/5

A series of experiments were designed and implemented to provide data concerning the effect of restorable calcium aluminate ceramic implants on new bone growth in the local area of the implant, and in in vivo biochemical responses. Rhesus monkeys were used as hosts for the implants in the form of total or partial circumferential replacement of femur sections. Radiographic

and biochemical analyses were obtained. Standard histological, scanning electron and light microscopy, light energy dispersive analysis, and electron-microprobe techniques were used in analyses of ceramic-bone specimens. Detailed results are compared to analysis of ceramic compositions and microstructures prior to implantation. Author (GRA)

N76-32832# Army Aeromedical Research Lab., Fort Rucker, Ala.

BLOOD PRESSURE MEASUREMENT IN A HIGH NOISE ENVIRONMENT, SELECT BIBLIOGRAPHY OF BOOKS, JOURNAL ARTICLES AND DOCUMENTS, 1963 - 1975

Sybil H. Bullock Jan. 1976 12 p refs

(AD-A021203; USAARL-Special-Bib-Ser-6) Avail: NTIS CSCL 06/12

Titles of books, journal articles, and documents are included in this select bibliography on blood pressure measurement in a high noise environment. Subjects covered include ultrasonics, automated and digital read-out devices for determining blood pressure. GRA

N76-32833# Naval Submarine Medical Research Lab., Groton, Conn.

THE EFFECT OF COMMON THERAPEUTIC DRUGS ON VISION Interim Report

S. M. Luria, Helen M. Paulson, Jo Ann S. Kinney, Christine L. McKay, and Mark S. Strauss 1 May 1975 69 p refs

(AD-A020346; NSMRL-808) Avail: NTIS CSCL 06/15

One therapeutic dose of five widely-used medicinal drugs (Aralen, Benadryl, Dexedrine, Digoxin, and Valium) was administered to 36 subjects. Measurements were made of the effects of the drugs on pupil size, intraocular pressure and the fundus, various aspects of color vision, the electrical activity of the brain, eye-movements and stereoacuity. A number of significant changes were observed despite the small size of the dosage and the number of subjects. The practical implications of the findings are discussed, as well as the value of visual psychophysical tests of pharmacological intoxication. Author (GRA)

N76-32834# Office of Naval Research, London (England).

INTERDISCIPLINARY APPROACHES IN SCIENCE: BIOELECTROCHEMISTRY AND BIORHEOLOGY AS NEW DEVELOPMENTS IN PHYSIOLOGY

Martin Blank 23 Jul. 1975 24 p

(AD-A013781; ONRL-12-75) Avail: NTIS CSCL 06/16

As science has developed into a more highly organized and automated activity, it appears to have changed in ways that have affected its traditional patterns of development. To overcome the constraints imposed by the new organization, scientists have formed interdisciplinary research areas as a creative way of approaching complex problems. this report reviews interdisciplinary research in general and two new areas that are developing in western europe, bioelectrochemistry and biorheology. GRA

N76-32835# Army Materiel Command, Texarkana, Tex. Intern Training Center.

PUPIL RECOVERY VERSUS BANDWIDTH/INTENSITY OF THE VISIBLE SPECTRUM Final Report

Brian W. Durtschi Dec. 1975 64 p refs

(AD-A020502; USAMC-ITC-02-08-76-401) Avail: NTIS CSCL 06/16

This research experiment was performed to investigate possible differences in pupil recovery times as the result of a light stimulus of separate visible bandwidths and intensities of the electromagnetic spectrum. An experiment was designed using dual intensity (10 and 20 foot candles) light of three separate bandwidths of the visible spectrum to measure the time of 50% pupil recovery from a constricted state. Twelve caucasian males with uncorrected normal vision were chosen as subjects for this experiment. Subjects were dark adapted to a very low (less than one foot candle) red (approximately 700 nm) light source. The pupil constriction-dilation sequence was initiated by a projected light of one of the two intensities and bandwidths of either 400-425 nm (blue), 500-520 nm (green), or 650-700 nm (red). This procedure provided 72 data points from a three variable-two level, randomized block factorial-fixed effect design. The parameter or data point of interest was the time of pupil recovery to a 50% redilation level following constriction. The data point was taken from measurements of pupil movement recorded on a series 800 Space Sciences TV Pupillometer. Conclusions drawn from the analysis are as follows: (1) The wavelength of a light stimulus affects pupil recovery times. (2) Higher intensities of a given wavelength light cause faster pupil recovery times. Author (GRA)

N76-32836# Utah Univ., Salt Lake City. Dept. of Bioengineering.

COMPARISON OF THEORETICAL AND EXPERIMENTAL ABSORPTION OF RADIO FREQUENCY POWER

Stewart J. Allen, Carl H. Durney, Curtis C. Johnson, and Habib Massoudi Dec. 1975 20 p refs

(Contract F41609-75-C-0022; AF Proj. 7757)

(AD-A022890; SAM-TR-75-52) Avail: NTIS CSCL 06/18

Power absorption calculations were performed for radiofrequency exposures (10-50 MHz) using prolate spheroid models, and these data were compared with experimental data obtained from prolate spheroid monkey and human phantoms, and live monkeys. Agreement of spheroid calculations with empirical spheroid data was excellent; however, it was found that ellipsoid models better approximate monkeys and humans. Author (GRA)

N76-32837# Washington Univ., Seattle. Electromagnetics Research Lab.

EFFECTS OF ELECTROMAGNETIC FIELDS ON THE NERVOUS SYSTEM

Chung-Kwang Chou and Arthur W. Guy Aug. 1975 132 p refs

(Contract N00014-75-C-0464; Grant NSF GK-34730; NR Proj. 201-054)

(AD-A022462; SR-6) Avail: NTIS CSCL 06/18

Contents: Electromagnetic Field-Biomaterial Interaction and Methods of Measurement; Effects of Electromagnetic Fields on Isolated Nerves and Superior Cervical Ganglia: Design of Waveguide Apparatus, and Calculation of Specific Absorption Rate; Effects of Electromagnetic Fields on Muscle Contraction; Effects of Electromagnetic Fields on Auditory System: Effect of Noise Masking on Threshold of Evoked Auditory Responses, Microwave-induced Cochlear Microphonics in Guinea Pigs. GRA

N76-32838# Army Research Inst. of Environmental Medicine, Natick, Mass.

THE AMELIORATION OF ACUTE MOUNTAIN SICKNESS BY STAGING AND ACETAZOLAMIDE

W. O. Evans, S. M. Robinson, D. H. Horstman, R. E. Jackson, and R. B. Weiskopf May 1975 27 p refs

(DA Proj. 3A7-62758-A-827)

(AD-A019592; USARIEM-M-36-75) Avail: NTIS CSCL 06/19

Treatment by four days residence at 1600M plus the administration of 500mg acetazolamide twice a day for the last two days at 1600M and the first two days at 4300M was compared with no treatment prior to ascent to 4300M for prophylaxis of acute mountain sickness. The treatment successfully prevented almost all symptoms of acute mountain sickness. It had no effect on the diminished capacity for maximal or prolonged heavy physical work. The treatment produced a relative acidosis and a comparatively greater arterial oxygen tension at 4300M. Author

N76-32839# Naval Submarine Medical Research Lab., Groton, Conn.

VISUAL EVOKED RESPONSES AND EEGS FOR DIVERS BREATHING HYPERBARIC AIR: AN ASSESSMENT OF INDIVIDUAL DIFFERENCES

Jo Ann S. Kinney, Christine L. McKay, and S. M. Luria 3 Jun. 1975 20 p refs

(MF51524004)

(AD-A020335; NSMRL-809) Avail: NTIS CSCL 06/19

In order to assess individual differences in susceptibility to nitrogen narcosis, a group of 16 men made repeated air dives to approximately 200 ft in a pressure chamber. The visual evoked response of the men at this depth revealed several decrements - in the response to a slow rate of stimulation, there was a highly significant reduction in a component around 160 msec in the response to a rapid rate of stimulation, marked losses in amplitude and increases in variability were found. The latter changes were related to diving experience while the former

were not. No significant changes were found in alpha or theta activity in the EEG. Author (GRA)

N76-32840# Army Materiel Command, Texarkana, Tex. Intern Training Center.
PROPOSED REVISIONS TO ANSI STANDARD C95.1 FOR EXPOSURE TO RADIO FREQUENCY AND MICROWAVE RADIATIONS Ph.D. Thesis. Final Report
James A. Wellsand Nov. 1975 69 p refs
(AD-A020681; USAMC-ITC-02-08-76-410) Avail: NTIS CSCL 06/18

The paper reviews the biological effects resulting from exposure to radio frequency and microwave radiations. The controversy over the relevance of the thermal and nonthermal effects is resolved in the light of present research findings. The quality of ANSI C95.1--Safety Level of Electromagnetic Radiation with Respect to Personnel--is examined. The basic conclusion is that the current guide number is acceptable. Proposals to improve the standard in other ways are made based on recent research. GRA

N76-32841# Army Nuclear Agency, Fort Bliss, Tex.
THE CALCULATION OF ABSORBED DOSE AND TISSUE TRANSMISSION FACTORS
A. S. Warshawsky 11 Nov. 1974 20 p refs
(AD-A012684; NUA-TM-1-74) Avail: NTIS CSCL 06/18

The source of tissue transmission factors used in the development of nuclear radiation casualty criteria from animal response experiments are documented. A byproduct of achieving this goal is the elimination of the many prevailing misunderstandings and misuses of the radiation related terms and quantities. The methodology and terminology used in calculating absorbed doses resulting from exposure to initial nuclear radiation are described. The tissue transmission factors used in developing initial nuclear radiation casualty criteria are calculated. Calculations of absorbed doses and the development of tissue transmission factors from those calculations are presented. GRA

N76-32842# Duke Univ., Durham, N.C. School of Engineering.
HEAT AND MASS TRANSFER IN THE HUMAN RESPIRATORY TRACT AT HYPERBARIC PRESSURES Final Report, 1 Apr. 1972 - 31 Dec. 1974
L. Sigfred Linderoth, Jr., E. A. Kuonen, M. L. Nuckols, and C. E. Johnson Nov. 1975 81 p refs
(Contract N00014-67-A-0251-0018; NR Proj. 201-148)
(AD-A021146) Avail: NTIS CSCL 06/19

The objective of the project was to mathematically model the heat loss process that occurs in the respiratory tract under deep ocean saturation diving conditions. This was approximated by determining the heat transfer characteristics of a branching scale model of the first two branches of the human lower respiratory tract. Heat transfer coefficients were obtained for a range of respiratory rates and respiratory gas mixtures for simulated ocean depths 0 to 1000 feet. These heat transfer coefficients were used to predict the heat loss from the respiratory tract of a diver by the successive application of the branching model, appropriately scaled, to simulate progressive units of the lung's anatomical configuration. GRA

N76-32843# Ohio State Univ., Columbus.
ROLE OF CARBON DIOXIDE IN INERT GAS NARCOSIS Annual Report, 1 May 1974 - 30 Apr. 1975
Harold S. Weiss and Lawrence W. Torley Dec. 1975 40 p refs
(Contract N00014-67-A-0232-0025)
(AD-A020984; OSURF-3916-A1) Avail: NTIS CSCL 06/19

The role of carbon dioxide and oxygen in high pressure narcosis was studied by exposing animals to hyperbaric conditions while maintaining them normoxic and normocapnic. Chickens were the experimental animals used. The unanaesthetized restrained birds were exposed to pressures up to 6 atmospheres absolute (ATA) in a hyperbaric chamber. Narcosis was estimated from changes in the visually evoked response (VER). The VER was recorded from the optic tectum by means of implanted bipolar fine wire electrodes. The VER was initiated by an external strobe light. A depression of the amplitude of the VER is considered to reflect narcosis. All animals showed a strong depression in VER amplitude on exposure to normoxic, normocapnic gas at 6 ATA when the inert component was nitrogen. No depression of VER was seen when the inert diluent was helium. Increasing lung PCO2 to 70 mmHg had no effect on VER. Relatively small changes in the body temperature (1.5 C) depressed VER and may explain some of the depression of VER seen by others with helium. Resistance to the high flow of gas through the bird was usually 7.5-10 cm H2O at a flow rate of 6 L/min ambient temperature and pressure; this resistance remains nearly constant over the 1-6 ATA pressure range investigated. GRA

N76-32844# School of Aerospace Medicine, Brooks AFB, Tex.
CORNEAL CURVATURE CHANGES DUE TO EXPOSURE TO A CARBON DIOXIDE LASER: A PRELIMINARY REPORT Preliminary Report, Mar. 1974 - Mar. 1975
James T. Gallagher Dec. 1975 17 p refs
(AF Proj. 6301)
(AD-A020987; SAM-TR-75-44) Avail: NTIS CSCL 06/18

A preliminary study indicates the need for a more rigorous investigation to determine the relationship between the infrared exposure required to produce curvature changes and that required to produce visible damage to the cornea. GRA

N76-32362 Michigan Univ., Ann Arbor. Highway Safety Research Inst.
SIMULATION OF HUMAN BODY RESPONSE TO CRASH LOADS
D. H. Robbins *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 365-380 refs (For availability see N76-32339 23-31)

N76-33127 National Research Council of Canada, Ottawa (Ontario). Division of Mechanical Engineering.
PSYCHOMOTOR TEST PERFORMANCE AND SLEEP PATTERNS OF AIRCREW FLYING TRANSMERIDIONAL ROUTES
Leslie Buck *In its* Quarterly Bull. of the Div. of Mech. Engr. and the Natl. Aeron. Estab. Jun. 1976 p 19-33 refs (For availability see N76-33125 23-99)

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N76-32845# Human Engineering Labs., Aberdeen Proving Ground, Md.
A HUMAN FACTORS ENGINEERING COMPATIBILITY ASSESSMENT OF THE DH-132 HELMET, COMBAT VEHICLE CREWMAN (CVC)
Nonnie F. Dickinson, Charles W. Houff, and Chester L. Woodward Dec. 1975 67 p refs
(AD-A020150) Avail: NTIS CSCL 06/17

The assessment of the DH-132 Helmet, conducted in November 1972, investigated the compatibility and interface of the DH-132 Helmet System with associated equipment, as a component of a protective system and as an individual helmet. This report explains in general terms and pictorially demonstrates those areas of concern that have not been sufficiently addressed in the design of an individual helmet system or its interfacing with its associated equipment. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N76-32846*# Hamilton Standard, Windsor Locks, Conn.
ELECTROCHEMICAL PERFORMANCE INVESTIGATIONS ON THE HYDROGEN DEPOLARIZED CO2 CONCENTRATOR

John R. Aylward Jul. 1976 41 p refs
(Contract NAS9-13679)
(NASA-CR-147871; SVHSER-7090) Avail: NTIS HC $4.00
CSCL 06K

An extensive investigation of anode and cathode polarization in complete cells and half cells was conducted to determine the factors affecting HDC electrode polarization and the nature of this polarization. Matrix-electrolyte-electrode interactions and cell electrolyte composition were also investigated. The electrodes were found to have normal performance capabilities. The HDC anode polarization characteristics were correlated with a theoretical kinetic analysis; and, except for some quantitative details, a rather complete understanding of the causes for HDC electrode polarization was formulated. One of the important finding resulting from the kinetic analysis was that platinum appears to catalyze the decomposition of carbonic acid to carbon dioxide and water. It was concluded that the abnormal voltage performance of the One Man ARS HDC cells was caused by insufficient cell electrolyte volume under normal operating conditions due to deficiencies in the reservoir to cell interfacing.
Author

N76-32847# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
STATIC PROPENSITY OF AIR FORCE UTILITY GARMENTS AND THE N-3B MODIFIED JACKET Final Report, Feb. - Aug. 1975
Preston C. Opt and Jack H. Ross Oct. 1975 31 p
(AF Proj. 7320)
(AD-A020957; AFML-TR-75-173) Avail: NTIS CSCL 06/17

This report describes and gives results of tests performed to measure the static propensity of the Air Force regular issue cotton utility uniform, a proposed polyester/cotton utility uniform, and the N-3B modified flying jacket. Static potential (voltage) was measured on the test subject after rubbing contact and separation of various garments. Tests were conducted in an environmental chamber at 70 F - 20% RH; 90 F - 20% RH; 70 F - 55% RH; and 15 F with resulting humidity. On the basis of the tests conducted and on analysis of the results, the proposed polyester/cotton utility uniform and the N-3B modified flying jacket present no greater hazard in the generation of static electricity than the 100% cotton utility uniform now in service.
Author (GRA)

N76-32848# Defence Research Establishment Ottawa (Ontario).
FIELD TRIAL OF AN EXPERIMENTAL COLD-WEATHER HEAD PROTECTOR
D. J. Hidson, S. H. H. Pang, and J. M. McAndless Dec. 1975 26 p refs
(AD-A020376; DREO-TN-75-27) Avail: NTIS CSCL 06/17

An experimental head-protection system, subjected to limited testing during the 1974 winter, was modified and field tested during Exercise Honky Tonk at Fort Churchill, Manitoba in January 1975. The modified headgear was found to provide complete protection against frostbite and to prevent spectacle frosting under extreme wind-chill conditions. Under milder conditions or during physical activity, the headgear was found to be too warm and spectacle frosting occurred. The modifications made to the headgear are discussed with respect to their effect on its performance. Recommendations are made for further modifications to correct problems encountered during the tests. GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

N76-32849 Cornell Univ., Ithaca, N.Y.
COMPUTER IMAGE PROCESSING FOR THE ENHANCEMENT OF ELECTRON MICROGRAPHS Ph.D. Thesis
Kenneth Brakeley Welles, II 1976 173 p
Avail: Univ. Microfilms Order No. 76-21141

Attempts to reconstruct electron micrographs with enhanced heavy/light atom contrast have not demonstrated any actual improvement of the images. Calculations performed with computer generated mathematical models of heavy atoms on carbon substrates demonstrate that dramatic heavy atom enhancement is possible. These calculations indicate that the failure of previous processing is due to the extreme sensitivity of the image reconstruction formula to errors in the alignment of the series of micrographs to be processed and errors in the microscope parameters associated with each micrograph. Computer programs were developed which provide the needed accuracy of micrograph alignment. However, to compute the defocus with the needed accuracy, it was found that a certain degree of spatial and temporal coherence must be present in the electron beam of the microscope. This coherence level is presently the limiting factor in the computer enhancement process. Dissert. Abstr.

N76-32850 Purdue Univ., Lafayette, Ind.
DATA BASE ORGANIZATION: AN ACCESS AND STORAGE METHOD Ph.D. Thesis
Sukumaran K. C. Subas 1975 197 p
Avail: Univ. Microfilms Order No. 76-20410

The design of access and storage schemes for a data base system is considered. A new version of the doubly-chained Multiple Attribute Tree (MAT) organization is proposed and its effectiveness evaluated. This work focuses on on-line systems and the retrieval of records for queries specifying values for several attributes. The three different aspects of the retrieval process are identified and taken into account in the effort to minimize the expected retrieval time per query. A novel feature of the method is the use of the MAT storage organization to hierarchically cluster the records within the data pages. This leads to a substantial reduction in the expected number of data pages that need be retrieved per query. Several real-life and generated data bases are used to demonstrate the effectiveness of the method in reducing the expected retrieval time per query. Dissert. Abstr.

N76-32851 State Univ. of New York, Stony Brook.
HARDWARE AND SOFTWARE DESIGN AND IMPLEMENTATION OF CELLULAR LOGIC PROCESSORS Ph.D. Thesis
Kuang-Shin Lin 1976 176 p
Avail: Univ. Microfilms Order No. 76-19716

An experimental Cellular Logic Array (CLA) processor was designed and constructed using PROM's for the cells. An array of these cells is designed to achieve speed-up improvement over conventional architecture for some special purpose operations, such as sorting, associative matching, and vector multiplications etc. Although it is connected to a PDP-15 computer via a direct memory access bus as an add-on unit, the CLA processor can function independently of, or cooperatively and in parallel with

the CPU with the help of a microprogrammed controller. All the operations performed by the CLA processor are supervised by software support in the PDP-15 computer which not only facilitates the use of the CLA processor, but also extends its hardware capabilities in dealing with oversized data. Dissert. Abstr.

N76-32852 California Univ., Los Angeles.
STUDIES IN THE COMPUTER-AIDED DESIGN OF CONNECTED SURFACES Ph.D. Thesis
Larry Ben Lichten 1976 286 p
Avail: Univ. Microfilms Order No. 76-20265

The specification, development, application, and partial implementation of a language and specialized data base management system was developed to create and utilize relationships between surfaces describing the exteriors of objects. The resulting system illustrates a computer approach to some of the problems of topological connectivity of surface elements used in the computer-aided design of aircraft, ships, and automobiles. A numerical geometry system for aircraft design was chosen as a basis for this study. Extensions to this geometrical data base's capabilities are described, including data structures and operators necessary to deal with connectivity problems.
Dissert. Abstr.

N76-32853 Purdue Univ., Lafayette, Ind.
FACTORS AFFECTING THE PROGRAM SIZE OF CONTROL FUNCTIONS OF OPERATING SYSTEMS Ph.D. Thesis
Atilla Elci 1975 142 p
Avail: Univ. Microfilms Order No. 76-20264

It is hypothesized that the length or size of the control functions of operating systems (CFOS) depends primarily upon the number of resources which it manages simultaneously. The resource categories and the size of a CFOS are defined, and a data base covering these two variables for forty operating systems is collected. Statistical analysis of the data base indicates exponential relationship between the size of a CFOS and the number of resources. A model for the size of a CFOS is developed, and a formula for that size given the number of resources is derived. The model states that the size or length is determined only by the number of resources managed, growing exponentially with that number. As long as a CFOS manages each of its resources simultaneously and in combination with all of the others, the identity of the individual resources is immaterial.
Dissert. Abstr.

N76-32854 California Univ., Santa Barbara.
AN INTERACTIVE ON-LINE DIGITAL IMAGE PROCESSING SYSTEM FOR ACOUSTIC IMAGE ENHANCEMENT Ph.D. Thesis
Chin-Hwa Lee 1976 381 p
Avail: Univ. Microfilms Order No. 76-20509

Feasible techniques to implement essential capabilities in a digital-image-processing system are presented. The system implemented represents a particular design which satisfies the requirements for performing acoustic image enhancement. A minicomputer is employed in this low-cost digital-image-processing system to manipulate the data as well as to control the image digitization and reconstruction. A novel scheme employing Bayer's technique was used to generate half-tone digital images on a standard storage oscilloscope or a plasma panel. A scan converted (analog memory) is used in conjunction with a television camera and monitor for image digitization and reconstruction. Features such as interpretive language, user program intervention, graphics display, and direct image reconstruction are discussed and considered in the context of the design process. Image signals from an acoustic-Bragg-diffraction-imaging system were accessed on-line and digitized. Background compensation techniques were found to be effective in reduction of both systematic noise and speckle. Spatial frequency windowing was shown to be effective in reduction of ringing. Dissert. Abstr.

N76-32855 Utah Univ., Salt Lake City.
INTERACTIVE COMPUTER GENERATED SURFACES WITH DOUBLE CURVATURE Ph.D. Thesis
Reese J. Goodwin 1976 128 p
Avail: Univ. Microfilms Order No. 76-20745

A method is described in which a certain class of shell structures is created interactively with a remote computer terminal coupled with an attached graphical display system. A surface patching routine is utilized to creat the desired shell surface. The complete surface is dependent only on corner coordinates, corner slopes, and corner twist information. Twists are related to the cross derivatives of the surface equation evaluated at the respective corner points. The surface equation is then manipulated into the desired surface by the use of approximately fifteen three- to five-letter words as commands with locational, directional, and numerical arguments. The graphical system is used exclusively for drawing the surface in orthographic or auxiliary views for verifying the accuracy of the desired shape. With the aid of an interface routine, the user is able to analyze the shell structure utilizing a general purpose finite element program. Dissert. Abstr.

N76-32856*# McDonnell-Douglas Astronautics Co., Houston, Tex.
SIMULATION VERIFICATION TECHNIQUES STUDY: SIMULATION SELF TEST HARDWARE DESIGN AND TECHNIQUES REPORT
1 Nov. 1974 487 p refs
(Contract NAS9-13657)
(NASA-CR-150920; MDC-E1150) Avail: NTIS HC$12.50 CSCL 09B

The final results are presented of the hardware verification task. The basic objectives of the various subtasks are reviewed along with the ground rules under which the overall task was conducted and which impacted the approach taken in deriving techniques for hardware self test. The results of the first subtask and the definition of simulation hardware are presented. The hardware definition is based primarily on a brief review of the simulator configurations anticipated for the shuttle training program. The results of the survey of current self test techniques are presented. The data sources that were considered in the search for current techniques are reviewed, and results of the survey are presented in terms of the specific types of tests that are of interest for training simulator applications. Specifically, these types of tests are readiness tests, fault isolation tests and incipient fault detection techniques. The most applicable techniques were structured into software flows that are then referenced in discussions of techniques for specific subsystems. Author

N76-32857*# McDonnell-Douglas Astronautics Co., Houston, Tex.
SIMULATION VERIFICATION TECHNIQUES STUDY. TASK REPORT 4: SIMULATION MODULE PERFORMANCE PARAMETERS AND PERFORMANCE STANDARDS
1 Aug. 1974 15 p refs
(Contract NAS9-13657)
(NASA-CR-150921; MDC-E1127; TR-4) Avail: NTIS HC $3.50 CSCL 09B

Shuttle simulation software modules in the environment, crew station, vehicle configuration and vehicle dynamics categories are discussed. For each software module covered, a description of the module functions and operational modes, its interfaces with other modules, its stored data, inputs, performance parameters and critical performance parameters is given. Reference data sources which provide standards of performance are identified for each module. Performance verification methods are also discussed briefly. Author

N76-32858# Finnish Meteorological Inst., Helsinki.
GEODALO, A GEOPHYSICAL DATA LOGGER
M. Hyppoenen, C. Sucksdorff, R. Torniainen, and V. Viinimaeki
Mar. 1976 26 p
(Rept-621.377.6; TR-10; ISBN-951-697-062-1; ISSN-0355-1733) Avail: NTIS HC $4.00

The construction of a data logger for the recording of geophysical data in digital form is described. The main properties of the logger are: (1) pulse-form data collection in 4 to 15 channels, (2) accurate time output by a digital crystal clock, which also conducts the main operations of the logger, (3) less than 1 W power consumption running over 48 h on its own 6 Ah batteries, and (4) acceptance of any tape deck with an electric start and stop as recorder of the data in digital form.
Author

N76-32859# Kernforschungsanlage, Juelich (West Germany).
CONCEPT FOR THE CONSTRUCTION OF THE ON-LINE

DATA PROCESSING SYSTEM IN THE KFA
H. L. Jordon, K. Abend, and G. Ballensiffen Dec. 1972 42 p In GERMAN
(JUL-902-DV) Avail: ERDA Depository Libraries HC $5.00

The report of the Data Processing Commission is presented. It was set up for the purpose of developing proposals for the construction and expansion of the total data processing in the Juelich Research Center. It would coordinate the supplying of all data acquisition and processing devices and evaluate their usefulness. It would submit proposals for their financing. The requirements placed on an on-line data processing system for the Research Center were formulated, and the current status of data processing at the Center was evaluated with recommendations for its improvement and expansion. Personnel and financial proposals were included. ERA

N76-32860# California Univ., Livermore. Lawrence Livermore Lab.
ADMINISTRATIVE MINICOMPUTER COMPLEX AS AN EXTENSION TO THE CENTRAL COMPUTING FACILITY
David L. Seibel 29 Jan. 1976 29 p Presented at the Minicomputers: The Applications Explosion Conf., San Francisco, 22-24 Mar. 1976
(Contract W-7405-eng-48)
(UCRL-77766; Conf-760308-1) Avail: NTIS HC $4.00

Lawrence Livermore Laboratory currently operates a large central computing facility essentially configured with 4 CDC 7600 computers and 2 CDC star 100 computers, a trillion bit storage device, and several communication networks including one composed of nearly 1,000 terminals for timesharing. It has been found, however, that many applications, including some administrative type functions, are better served by small minicomputer systems rather than the large computing complex. A survey of those minicomputer applications which are primarily oriented toward the business functions of the Laboratory is presented. Author (ERA)

N76-32861# California Univ., Livermore. Lawrence Livermore Lab.
DISPLAY OCTAL DEBUGGING TECHNIQUE (DODT-80) FOR THE MCS 80 MICROCOMPUTER
J. M. Spann 15 Jan. 1976 21 p
(Contract W-7405-eng-48)
(UCRL-51970) Avail: NTIS HC $3.50

The DODT-80 is an octal debugging routine for the Lawrence Livermore Laboratory (LLL) MCS-80 microcomputer system the CPU of which is an Intel 8080 microprocessor. This routine allows the user to examine and modify all of the memory that is available to the microcomputer and to transfer program control to the created program. The DODT-80 has the capability of operating from simple keyboard commands and displaying both inputs and results on a CRT terminal. Author (ERA)

N76-32862# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
CONTOUR PLOTTING FROM ARBITRARILY SPACED DATA POINTS WITHIN A REGION OF ARBITRARY SHAPE
M. R. Davidson Oct. 1975 15 p refs
(AAEC/E-368) Avail: ERDA Depository Libraries HC $3.50

A triangular mesh with data points as vertices is determined. Points on the contours are calculated by linear interpolation along triangle sides. Allowance for general boundary shapes gives the method applications in physics and engineering. Author (ERA)

N76-32863# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
SIMPLIFIED APPLICATION OF ELECTRONIC DATA PROCESSING IN A NATURAL SCIENCE AND TECHNOLOGY SPECIAL LIBRARY IN COMBINATION WITH AN IMPROVED LITERATURE DESCRIPTION
E. Bretnuetz Oct. 1975 50 p In GERMAN
(PTB-ATWD-6) Avail: ERDA Depository Libraries HC $4.00

A pilot project in a special library for natural science and technology to record bibliographic data on several kinds of literature within a simplified scheme and to process them in a computer by simple programs is described. The printout consists of several lists arranged according to several aspects. At the same time a relevant thesaurus is tested as to its suitability for an improved description of the literature. The results show that the literature handled is identified sufficiently within this simplified scheme. After supplementation by some special terms, the thesaurus can be used for a deeper analysis of the literature. Author (ERA)

N76-32864# California Univ., Livermore. Lawrence Livermore Lab.
NEWORLD: A WORLD DYNAMICS CODE FOR ASSESSING THE IMPACT OF SPACE COLONIZATION
J. P. Vajk 5 Jan. 1976 43 p refs
(Contract W-7405-eng-48)
(UCID-17003) Avail: NTIS HC $4.00

Three sections detail the model used. Section 1 contains a list of variables used, their definitions, and the dimensions or units of each variable. Section 2 contains the variable declarations and storage allocations for the program, while Section 3 lists the entire program. The programming language used is LLLTRAN, the Livermore dialect of FORTRAN 4. This dialect contains a number of features not found in ANSI FORTRAN; these are documented in Reference 1. Calls to subroutines which do not appear in the listing here are to library subroutines (ORDERLIB) which are documented in Reference 2. Author (ERA)

N76-32865# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
A USER'S GUIDE TO THE CSL VISION SYSTEM
W. E. Synder and V. C. Jones Jan. 1976 48 p refs
(Contract DAAB07-72-C-0259)
(AD-A023438; R-714; UILU-ENG-76-2202) Avail: NTIS CSCL 09/2

The staff of the Coordinated Science Laboratory at the University of Illinois has developed a moderate resolution, high speed system for inputting images to a computer. The system is capable of a resolution of 504x476 points of eight bits of grey scale each. This resolution can be obtained only by taking multiple pictures. In any one field of scan (16 ms) a picture consisting of 252x238 points of six bits each can be read in. Author (GRA)

N76-33126 National Research Council of Canada, Ottawa (Ontario). Division of Mechanical Engineering.
COMPUTER MODELING AND SIMULATION HANDBOOK
R. E. Gagne *In its* Quarterly Bull. of the Div. of Mech. Engr. and the Natl. Aeron. Estab. Jun. 1976 p 1-17 refs Repr. from Simulation, vol. 26, no. 6, May 1976 p 147-161 (For availability see N76-33125 23-99)

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N76-32866 California Univ., San Diego.
POLYNOMIAL ALGORITHMS FOR CERTAIN GRAPH-THEORETIC Ph.D. Thesis
Ann Marie Walsh 1976 99 p
Avail: Univ. Microfilms Order No. 76-20338

The tasks of determining whether or not in any given graph G there exists a Hamiltonian circuit, a clique of size k, a clique cover of size k or a coloring of size k were undertaken. An approach other than that of searching for algorithms which work well in all cases was taken. Two different local properties of a graph are considered. The first is of the type each subgraph of order K contains at least L edges and the second is of the type given any two disjoint sets of vertices S sub 1 and S sub 2 of order K, J respectively, there is at least one edge connecting a vertex in S sub 1 with a vertex in S sub 2. In addition, a polynomial algorithm which finds a clique of size no less than the lower bound, an algorithm which finds a clique cover of size no greater than the upper bound and an algorithm which constructs a Hamiltonian circuit when the designated conditions are satisfied are presented. Dissert. Abstr.

N76-32867 George Washington Univ., Washington, D.C.
SENSITIVITY ANALYSIS IN PARAMETRIC NONLINEAR PROGRAMMING Ph.D. Thesis
Robert Leo Armacost 1976 261 p
Avail: Univ. Microfilms Order No. 76-20749

Parametric sensitivity analysis for a general nonlinear programming problem is examined and developed from both a general, algorithm-independent and an algorithm-dependent point of view. Specifically, sufficient conditions are given for the existence of partial derivatives taken with respect to the problem parameters that represent the first order sensitivity of a Kuhn-Tucker triple and the first and second order sensitivity of the optimal value function. With these conditions holding, formulas were developed to calculate efficiently the various partial derivatives when a Kuhn-Tucker triple is known. Additionally, algorithmic approaches were considered for estimating the partial derivatives which include penalty function and augmented Lagrangian methods. A theory also was developed for general sequential algorithms. Detailed results were developed for the logarithmic-quadratic loss penalty function and were then computer-implemented. Computational experience, applications, sample calculations and user instructions for the computer program are included. Dissert. Abstr.

N76-32868 Texas A&M Univ., College Station.
A HIGH LEVEL COMPUTER CONTROL LANGUAGE Ph.D. Thesis
Robert Trueman Tomlinson 1976 207 p
Avail: Univ. Microfilms Order No. 76-20636

A set of primitive operators is developed for directing the progress of a computer job. These operators form the core of a high level language, based on the ALGOL-60 syntax, intended to be used as a replacement for existing job control languages. The significant properties of a compiler and macro processor for the control language are described. Particular emphasis is given to the actions of each primitive at execution time. An interpreter structure to process the primitives is developed in terms of a hypothetical operating system. A discussion of job scheduling includes the possibilities of improved system performance based on the selection of a compatible job mix. The correspondence between existing job control languages and the new control language is shown by a set of examples. Typical job streams from four existing operating systems are translated into the new control language. The new capabilities of the control language are shown. Dissert. Abstr.

N76-32869 Detroit Univ., Mich.
INCREASED TRANSFER LINE PRODUCTIVITY UTILIZING SYSTEMS SIMULATION Ph.D. Thesis
Leo Eugene Hanifin 1975 296 p
Avail: Univ. Microfilms Order No. 76-20415

A set of computer programs was developed which simulates a transfer line's configuration and management. This simulation model is programmed in the General Purpose Simulation Systems language and operates within an environment which duplicates the conditions in a real plant. This environment is generated from a detailed logging of a specific transfer line. The following changes in transfer line design and management were simulated: incorporation of banks (in-process storage) of various capacities and locations, the addition of a second jobsetter to the line, increasing the speed of the line's operation and decreasing the duration of downtimes. The results of one line's simulation are presented. The main effects and interactions are discussed for all five factors. For that line, it was found than an increase in net production of over 30% could be attained by enacting the above changes at levels feasible in the plant. Dissert. Abstr.

N76-32870 Arizona Univ., Tucson.
SEQUENTIAL EFFECT ON IMPROVING FLOWTIME OR LEAST-COST TESTING SEQUENCE PROBLEMS Ph.D. Thesis
Thomas Lloyd Webster 1976 177 p
Avail: Univ. Microfilms Order No. 76-20435

An algorithm was presented which could be used to solve the restricted problem of improving an objective function a specified amount by making a single improvement. The algorithm in general reduced the number of required calculations to find the set of all possible answers. Next, three different cost values were assigned to the possible values which could be improved. Mathematical programming techniques were used to determine the values to improve so that a specified value of the objective function could be attained at a minimum total improvement cost. The required calculations were shown to be extensive, and so, finally, two heuristic solution procedures were developed. Both heuristics were tested on numerous problems. The results indicated that different sequences could affect an improvement effort. Dissert. Abstr.

N76-32871 New York Univ., N.Y.
A COMPREHENSIVE SURVEY OF PARSING ALGORITHMS FOR PROGAMMING LANGUAGES Ph.D. Thesis
Philip Jonathan Owens 1976 656 p
Avail: Univ. Microfilms Order No. 76-19532

The major formal parsing algorithms for context-free grammars to be found in the computing literature are surveyed. Algorithms in related areas -- grammar transformations, the recognition of regular sets, and techniques for space and time optimization of parsers -- are also included. All of the algorithms are presented from the point of view of a unified and consistent set of conceptions about the parsing process. The algorithms are described informally in a structured expository style that attempts to get at the how and why of each algorithm. The algorithms are also described formally and precisely in the form of debugged programs in the set-oriented language SETL. The formal algorithms follow from and closely reflect the informal expositions. Dissert. Abstr.

N76-32872 Texas A&M Univ., College Station.
DYNAMIC MEMORY MANAGEMENT ALGORITHMS IN A PAGED MEMORY ENVIRONMENT Ph.D. Thesis
David Sherwin Burris 1976 122 p
Avail: Univ. Microfilms Order No. 76-20570

Algorithms are presented which dynamically cluster pages of a problem program based on past program behavior (i.e., reference string patterns) in a demand paged virtual memory environment. The objective of these algorithms is to minimize the number of page faults encountered by a program during execution, while at the same time to use memory page frames efficiently. Dynamic clusters of time and reference related pages are built during a program execution time. Dissert. Abstr.

N76-32873 Southern Methodist Univ., Dallas, Tex.
HASH CODING TECHNIQUES Ph.D. Thesis
Thomas Carl Irby 1976 146 p
Avail: Univ. Microfilms Order No. 76-19460

Several new hash codes and hash coding procedures were developed which greatly reduce the table size restrictions of other methods. These codes can be implemented with approximately the same efficiency as existing hash codes. In certain cases the table size can be chosen to take advantage of machine dependent features which result in an extremely efficient implementation. A hash coding procedure which guarantees minimum retrieval time for a given table and hash code was developed. This procedure takes more time as the items are inserted in the table. An alternate procedure is also presented which does not guarantee minimum retrieval but is computationally more efficient. The utility of these procedures was demonstrated using the operation code table of a typical assembler. Results show that items can be retrieved from a hash table ordered for retrieval in approximately half the time of a table using the binary search algorithm. Dissert. Abstr.

N76-32874 North Carolina Univ., Chapel Hill.
CONFIGURABLE APPLICATIONS FOR SATELLITE GRAPHICS Ph.D. Thesis
Griffith Askew Hamlin, Jr. 1975 159 p
Avail: Univ. Microfilms Order No. 76-20032

An approach to software for satellite graphics is advocated in which the division of labor between the host and satellite computers can be easily changed after an application program has been written. A software system, known as CAGES, was implemented which uses this approach. CAGES substantially simplifies the application programmer's task of programming host and satellite computers, and can be extended to an n-computer network. Distributing the functions of a suitably structured application program between the two computers can result in

better performance than when all application specific functions are resident on the host computer, with only general purpose software satellite-resident to access graphics devices. A mathematical model of a distributed program and a set of programming guidelines aid the application programmer in producing an application structure suitable for distributed execution.
Dissert. Abstr.

N76-32875 Michigan Univ., Ann Arbor.
AGPSS: A GRAPHICAL PROCESS SIMULATION SYSTEM Ph.D. Thesis
Surendra Pal Singh 1976 518 p
Avail: Univ. Microfilms Order No. 76-19239

An interactive graphics digital computer executive program was developed for simulating steady-state operation of chemical processes. This program utilizes a graphics terminal to communicate with the computer. The AGPSS system can be run on both refreshed-display and storage tube terminals. The executive program has a highly modular structure and consists of major routines for handling the input and output of graphical information, managing the data structure, drawing the process flowsheet, analyzing the flowsheet for recycle loops, modelling and sequencing the unit calculations, evaluating needed physical properties, and displaying simulated results. The AGPSS system uses a relational data structure based on set theory. The AGPSS was written using the FORTRAN (level G) language. Results for simulation of a reasonably complex process along with cost data for using AGPSS are included. Dissert. Abstr.

N76-32876 Arizona State Univ., Tempe.
MULTIVARIABLE ANALYSIS PROGRAMMING Ph.D. Thesis
Patrick John Condon 1976 177 p
Avail: Univ. Microfilms Order No. 76-19816

Data analysis is conducted of a sample survey problem where N observations are collected, consisting of a dependent variable and multiple independent variables. The purpose of the analysis is to explain variation in the dependent variable as a function of the independent variables. The methodology developed is less restrictive in the assumptions than other techniques such as multiple linear regression. The predictor model assigns observations to a number of subsets based on the value of their independent variables. The dependent variable is then estimated as the average of all sampled dependent variable values in that subset, plus an error term. The objective is to minimize the errors squared. Contraints are imposed to prevent subgroups from becoming trivial. The state of the art is advanced in several ways: (1) an implicit enumeration algorithm is developed to generate an optimum solution; (2) a modified version of this algorithm is shown to outperform similar algorithms by other authors; and (3) possible theories for a multiple dependent variables and an F-like ratio are outlined. Dissert. Abstr.

N76-32877*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA-AMES THREE-DIMENSIONAL POTENTIAL FLOW ANALYSIS SYSTEM (POTFAN) EQUATION SOLVER CODE (SOLN) VERSION 1
J. E. Davis (Computer Sciences Corp., Mountain View, Calif.), W. S. Bonnett (Acurex Corp., Mountain View, Calif.), and R. T. Medan Jul. 1976 154 p refs
(NASA-TM-X-73074; A-6338) Avail: NTIS HC $6.75 CSCL 09B

A computer program known as SOLN was developed as an independent segment of the NASA-Ames three-dimensional potential flow analysis systems of linear algebraic equations. Methods used include: LU decomposition, Householder's method, a partitioning scheme, and a block successive relaxation method. Due to the independent modular nature of the program, it may be used by itself and not necessarily in conjunction with other segments of the POTFAN system. Author

N76-32878*# System Development Corp., Santa Monica, Calif.
IMAGE DATA PROCESSING SYSTEM (IDAPS) SOFTWARE DOCUMENTATION, S-056 EXPERIMENT. VOLUME 1: SYSTEM SOFTWARE DESCRIPTION
30 Jun. 1976 155 p 3 Vol.
(Contract NAS8-31667)
(NASA-CR-150002; TM-HU-039/000/01-Vol-1) Avail: NTIS HC $6.75 CSCL 09B

Information for personnel with programming backgrounds to understand and follow the logic of the software which supports the IDAPS system hardware configuration is presented. J.M.S.

N76-32879*# System Development Corp., Santa Monica, Calif.
IMAGE DATA PROCESSING SYSTEM (IDAPS) USER MANUAL, S-056 EXPERIMENT. VOLUME 1: SYSTEM DESCRIPTION. VOLUME 2: BATCH IDAPS. VOLUME 3: INTERACTIVE IDAPS
31 Mar. 1975 205 p
(Contract NAS8-30740)
(NASA-CR-150003; TM-HU-037/000/00-Vol-1; TM-HU-037/000/00-Vol-2; TM-HU-037/000/00-Vol-3) Avail: NTIS HC $7.75 CSCL 09B

Image data processing system (IDAPS) developed to satisfy the image processing requirements of the Skylab S-056 experiment is described. The S-056 experiment was designed to obtain high-resolution photographs of the sun in the far ultraviolet, or soft X-ray, portion of the electromagnetic spectrum. Thirty-five thousand photographs were obtained by the three flights of the program; and, faced with such a massive volume of imagery, the designers of the experiment decided to develop a computer-based system which would reduce the image processing workload. The purpose of the IDAPS User Manual is to give the IDAPS user the necessary information and instructions to effectively utilize the system. Author

N76-32880# Sandia Labs., Albuquerque, N.Mex.
BINARY COMPUTER GENERATED HOLOGRAMS AS SPATIAL FILTERS
Bruce D. Hansche 1976 9 p refs Presented at the Topical Meeting on Image Process., Pacific Grove, Calif., 24 Feb. 1976
(SAND-75-6076; Conf-760206-1) Avail: NTIS HC $3.50

The Generalized Binary Computer Generated Hologram is an algorithm which makes efficient use of graphics devices, which can plot only a limited number of points, to generate holographic spatial filters. The nature of the set of complex amplitudes one can code with this algorithm was studied. The main topic is amplitude quantization noise. It is shown that, since the quantization steps vary in size, the optimum signal normalization is not necessarily that which uses all the quantization steps. The amplitude quantization noise is analyzed in several types of real-values holograms to demonstrate this behavior. The results of a measurement of errors in dot size and dot position on a storage tube terminal are given and related to the analysis of amplitude quantization noise. ERA

N76-32881# California Univ., Berkeley. Lawrence Berkeley Lab.
IMPROVED SHIFT STRATEGY FOR THE QR-ALGORITHM FOR REAL HESSENBERG MATRIXES
Illka Karasalo Jan. 1976 19 p refs
(Contract W-7408-eng-48)
(LBL-4648) Avail: NTIS HC $3.50

Some experimental results on the behavior of the QR algorithm for real Hessenberg matrices are presented, with shifts calculated from a p x p lower right-hand submatrix where p may be > 2. Convenient implementation of one such shifting strategy in a programming language is discussed; recursive procedure calls are permitted by modifying slightly the ALGOL procedure HQR. In the comparison the modified procedure gives in general a 15 to 20% reduction of the total operations count for transforming the Hessenberg matrix to block triangular form (with diagonal blocks of order less than or equal to 2) and updating the product of the orthogonal transformation matrices. ERA

N76-32882# Los Alamos Scientific Lab., N.Mex.
JACOBI ALGORITHMS FOR INTEGERS
R. W. Johnson and M. S. Waterman Dec. 1975 15 p refs
(Contract W-7405-eng-26)
(LA-6187-MS) Avail: NTIS HC $4.50

Jacobi's algorithm, usually given for pairs of reals, has an integer analog for triples of integers. This algorithm and an alternative algorithm are presented along with the connection with computing greatest common divisors. A technique is generalized for efficient computation of Jacobi algorithms. Listings

of FORTRAN programs for these procedures are given.
Author (ERA)

N76-32883# Ames Lab., Iowa.
DEVELOPING SOFTWARE FOR A MINCOMPUTER LABORATORY
P. A. Bulger, C. L. Smith (Southern Illinois Univ.), and C. T. Wright 1976 10 p refs Presented at the ACM Conf. on Programming Micro/Mini Computers, New Orleans, 4 Mar. 1976
(Contract W-7405-eng-82)
(IS-M-58; Conf-760302-2) Avail: NTIS HC $3.50

Minicomputer systems have tremendous potential as laboratory devices in the teaching of computer science. For this potential to be realized, however, appropriate software is needed to support the various laboratory excercises. One approach to the development of such laboratory software is described. ERA

N76-32884# California Univ., Livermore. Lawrence Livermore Lab.
BABY BROTHER SYSTEM
J. E. Albert Nov. 1975 16 p Presented at the ACM Conf. on Programming Micro/Mini Computers, New Orleans, 4-6 Mar. 1976
(Contract W-7405-eng-48)
(UCRL-77453; Conf-760302-1) Avail: NTIS HC $3.50

A computer network performance monitoring system is described. Its principal components are a PDP-11/10 processor with 8K of memory, a 16-channel teletype multiplexer, support teletypes, and teletype lines to network concentrators. The primary functions are automatic hardware checking, statistics collection, and automatic supervision of external programs on other host computers. A multiprocessing operating system dedicated to supporting this mission and the processes that accomplish these tasks are described. Author (ERA)

N76-32885# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER ALGORITHM TRANSPOSING LARGE MATRICES USING LIMITED PRIMARY STORAGE
R. E. Twogood and M. P. Ekstrom 21 Nov. 1975 6 p ref Presented at the 9th Hawaii Intern. Conf. on System Sci., Honolulu, 6-8 Jan. 1976
(Contract W-7504-eng-48; ARPA Order 2436)
(UCRL-77110; Conf-760105-2) Avail: NTIS HC $3.50

Eklundh's fast matrix transposition algorithm for transposing a 2/sup n/ x 2/sup n/ matrix is extended to the general case where 2/sup j/(j greater than or equal to 1) of its rows will fit into primary storage. The performance characteristics of the extension are described and subsequently compared with those of Eklundh. Author (ERA)

N76-32886# Oak Ridge National Lab., Tenn.
ADTABLE: AN ORCHIS PROGRAM FOR TABULAR REPORTS OF INFORMATION IN ADSEP DATA SETS
V. A. Singletary Jan. 1976 76 p refs
(Contract W-7405-eng-26)
(UCCND-CSD-INF-59) Avail: NTIS HC $5.00

This report is a user guide for the ADTABLE computer program. It describes how the program can be used, the preprocessing required on the input file, how to control the computer resources, and how to specify program control. The program is an integral part of the Oak Ridge Computerized Hierarchical Information Systems (ORCHIS). It is a multipurpose report generator that can produce tabular displays of information from ADSEP produced files stored in textual or computational form. Author (ERA)

N76-32887# California Univ., Livermore. Lawrence Livermore Lab.
TRIX: AN INTERACTIVE, INTERPRETIVE LANGUAGE FOR MANIPULATING STRINGS OF CHARACTERS
H. Moll 22 Dec. 1975 52 p refs Revised
(Contract W-7405-eng-48)
(UCID-30100-Rev-1) Avail: NTIS HC $4.50

TRIX is a language for manipulating strings of characters. It consists of functions and a syntax for assembling those functions into named procedures called macros. A program written for the TRIX interpreter is called a dialect. The TRIX user writes a dialect (program) by writing a series of macros as a disk file, and then reads in (interprets) the dialect and executes the macros to carry out operations on a text file. Dialects run under TRIX are used for text editing, where text can be source code (e.g., a FORTRAN disk file) or English-language text. This report describes in detail the basic TRIX functions, the TRIX syntax, and brief examples of macros, showing applications to text-editing procedures. TRIX is an executable controllee (written in assembly language) available on the CDC 6600 and 7600 computers of the Livermore time-sharing system. Author (ERA)

N76-32888# California Univ., Livermore. Lawrence Livermore Lab.
CONCORD: A WORD INDEX GENERATOR FOR ARBITRARY TEXT STRINGS
J. E. Ramus 23 Nov. 1975 17 p refs
(UCID-30126) Avail: NTIS HC $3.50

The CONCORD computer program which creates a concordance for arbitrary text strings is described. These alphabetically ordered word indexes are used as lookup tables for bibliographic, adminstrative, or scientific information and data. The program selects essential terms from the input text according to an algorithm using user-specified ACCEPT or REJECT lists. The program contains options for printing the index terms on either the left or right side of the page to facilitate visual lookup on microfiche or on single-page computer-printed output. Large files containing 50,000 references are produced in about 10 minutes of CDC 7600 computer time. Author (ERA)

N76-32889# Bureau of Labor Statistics, Washington, D.C. Office of Systems and Standards.
TABLE PRODUCING LANGUAGE SYSTEM INSTALLATION INSTRUCTIONS, VERSION 3.5 USERS GUIDE AND OPERATIONS GUIDE, INCLUDING PRINT CONTROL LANGUAGE AND CODEBOOK LANGUAGE
Stephen B. Levenson Jul. 1975 257 p refs
(PB-249834/3; BLS/DF-76/001A) Avail: NTIS HC$9.00 CSCL 09B

A computer system designed to select, restructure, cross tabulate, and display statistical data is reported. The system was designed to solve some problems connected with the collection of large volumes of data from which cross tabulations must be produced in a wide variety of formats. The primary goal of TPL is to provide the individuals who need tables with the option of obtaining these tables directly from the computer. The syntax of the language allows the user to construct expressions representing the desired tables and auxiliary operations. GRA

N76-32890# Naval Underwater Systems Center, New London, Conn.
SIMULATION WITH SYSTID: RUNNING AND MODELLING
Joseph J. Bednarz, Jr. 13 Feb. 1976 103 p refs
(AD-A022456; NUSC-TD-5319) Avail: NTIS CSCL 09/2

The System Time Domain (SYSTID) computer program was developed for NASA by Systems Associates, Inc. in 1971 for simulation of electronic communication systems. SYSTID is a two-phase computer program which uses z-transform digital sampling techniques and has a library of models available for use in simulations. The program was written for operation with A UNIVAC 1108 EXEC II operating system; therefore, it was necessary to convert it for running under EXEC 8 at NUSC. The conversion process involved rewriting of some of the SYSTID PHASE I subroutines for compatibility with EXEC 8. The EXEC 8 runstream necessary for running SYSTID at NUSC is described. Examples of modeling with SYSTID for a simple wave generator and a second order positional servomechanism are given. These examples help to show that SYSTID can be useful for modelling of systems operating at frequencies from nearly DC to RF while using a system block diagram/subsystem transfer function response. Author (GRA)

N76-32891# National Bureau of Standards, Washington, D.C. Systems and Software Div.
MUMPS LANGUAGE STANDARD Final Report, Feb. 1974 - Jun. 1975
Joseph T. ONeill Jan. 1976 162 p refs Sponsored in part

by Natl. Center for Health Services Res.
(PB-253282/8; NBS-HB-118; LC-75-619261) Avail: NTIS HC $6.75 CSCL 09B

This NBS Handbook contains a description of various aspects of the MUMPS computer programming language. Part 1, the MUMPS Language Specification, consists of a stylized English narrative definition of the MUMPS language which was adopted and approved for publication as a Type A release of the MUMPS Development Committee on March 12, 1975. Part 2, the MUMPS Transition Diagrams, represents a formal definition of the language described in Part 1, employing a form of line drawings to illustrate syntactic and semantic rules governing each of the language elements. GRA

N76-32892# Michigan Univ., Ann Arbor. Graduate School of Business Administration.
APPLICABILITY OF MICROPROGRAMMING TO THE TRANSLATION OF DATA AND DATA BASE MANAGEMENT SYSTEMS
David J. DeWitt Jun. 1975 16 p refs
(Contract DCA100-72-C-0019; ORA Proj. 011067)
(AD-A023614; Working-Paper-902) Avail: NTIS CSCL 09/2

This paper continues the development of data base management system migration methodology by investigating the role of microprogramming. While this research is basic to achieving behavioral equivalence of computing system hardware, it has further application towards achieving language compatibility and the development of data translators. GRA

N76-32893# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
AN AUTOMATIC CLUSTER ANALYSIS ALGORITHM Final Report, Jun. 1972 - May 1975
Roger A. Gagnon Feb. 1976 23 p refs
(AF Proj. 7233)
(AD-A022898; AMRL-TR-75-59) Avail: NTIS CSCL 12/1

This technical report presents an algorithm that finds clusters in a set of data. Examples of applications of this algorithm are the separation of targets from clutter in reconnaissance imagery and the determination of prototypes from any set of data represented in vector form, such as hand-printed letters, electrocardiographic data and electroencephalographic data. The approach used is to start with the closest vector to the data mean as the trial prototype for the first cluster. A hypersphere that is centered on the trial prototype is then defined. The radius of the hypersphere is incremented, and the prototype updated, until one of several termination criteria is met. The furthest vector from the resultant cluster is then used to start the search for the next cluster and the process is repeated until no new clusters can be located. The algorithm also merges clusters which are their own closest neighbors, are sufficiently close to each other, and result in a sufficiently small variance. These criteria were empirically derived and are related to data statistics.
Author (GRA)

N76-32894# California Univ., Los Angeles. Western Management Science Inst.
PARAMETRIC AND POSTOPTIMALITY ANALYSIS IN INTEGER LINEAR PROGRAMMING
A. M. Geoffrion and R. Nauss (Missouri Univ., St. Louis) Jan. 1976 37 p refs Sponsored in part by NSF
(Contract N00014-69-A-0200-4042; NR Proj. 047-111)
(AD-A023278; Working-Paper-246) Avail: NTIS CSCL 12/1

Postoptimality analysis and parametric optimization techniques are fully developed aspects of linear programming. In the context of integer linear programming, however, these aspects have barely begun to be developed. The purpose of this paper is to take stock of what is known about this topic and to lay the foundation for future progress. Our conceptual starting point is the notion that, in practical applications, typically one is faced not with a single numerical integer linear program to solve but rather with an entire family of numerical problems of interest. The members of the family may all have the same structure but differ as to the values of one or more coefficients, or they may even have different (but related) structures. The scope of this paper is limited to the first mentioned case. GRA

N76-32895# Harvard Univ., Cambridge, Mass. Aiken Computation Lab.
EXTRAPOLATED FAST DIRECT ALGORITHMS FOR ELLIPTIC BOUNDARY VALUE PROBLEMS
Randolph E. Bank and Donald J. Rose Apr. 1976 53 p refs
(Contract N00014-75-C-0243; NR Proj. 044-454)
(AD-A023424; TR-7-76) Avail: NTIS CSCL 12/1

Several new direct methods for solving systems of equations arising from finite difference discretization to elliptic boundary value problems on regular domains in the plane are described in this document. GRA

N76-32363 TIME/DATA Corp., Palo Alto, Calif.
TEST DATA REDUCTION AND PROCESSING
Loren D. Enochson *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 381-404 refs (For availability see N76-32339 23-31)

N76-32368 Commonwealth Associates, Inc., Jackson, Mich.
SUMMARY OF GENERAL PURPOSE PROGRAMS
Suresh K. Desai *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 529-536 refs (For availability see N76-32339 23-39)

62 COMPUTER SYSTEMS

Includes computer networks.

N76-32896 Carnegie-Mellon Univ., Pittsburgh, Pa.
OPERATOR FUNCTIONS INDUCED BY NETWORK CONNECTIONS Ph.D. Thesis
Thomas Daniel Murley 1976 85 p
Avail: Univ. Microfilms Order No. 76-19333

Certain analogs of Kirchhoff's laws are proposed in which the currents and voltages become vectors, and the resistors become certain types of linear operators. This gives rise to operator (and matrix) functions. Several properties of these functions are shown. Dissert. Abstr.

N76-32897 Virginia Polytechnic Inst. and State Univ., Blacksburg.
A HEURISTIC METHOD FOR REDUCING MESSAGE REDUNDANCY IN A FILE TRANSFER ENVIRONMENT Ph.D. Thesis
William Robert Bodwell 1976 187 p
Avail: Univ. Microfilms Order No. 76-19881

The Substitution Method which minimizes data transfer between hosts required to reconstruct user JCL files, FORTRAN source files, and data files is developed. The technique requires that a set of user files for each category of files be examined to determine the frequency distribution of symbols, fixed strings, and repeated symbol strings to determine symbol and structural redundancy. Information gathered during the examination of these files when combined with the user created Source Language Syntax Table generate Encoding/Decoding Tables which are used to reduce both symbol and structural redundancy. The Encoding/Decoding Tables allow frequently encountered strings to be represented by only one or two symbols through the utilization of table shift symbols. The table shift symbols allow less frequently encountered symbols of the original alphabet to be represented as an entry in a Secondary Encoding/Decoding Table. A technique is described which enables a programmer to easily modify his FORTRAN program such that he can take advantage of the Substitution Method's ability to compress data files by removing both informational and structural redundancy. Dissert. Abstr.

N76-32898# California Univ., Livermore. Lawrence Livermore Lab.
STATIC TOOLS FOR THE ANALYSIS OF OPERATING SYSTEM SECURITY
Jeffrey C. Huskamp, W. G. Frickel, and D. A. Webb 30 Dec. 1975 23 p refs Presented at the 1976 Natl. Computer Conf., New York, 7-10 Jun. 1975 Sponsored by ERDA
(UCRL-77624) Avail: NTIS HC $3.50

Analytic tools are used to automate the system security analysis function. With these tools, each step of the analysis methodology can be excuted faster and more thoroughly than

by manual methods alone. One useful analytic tool is the static informational tool that operates on a data base constructed from the system listings. The implementation of a static informational tool for system security analysis is presented and design considerations for future tools of this type are given.
Author (ERA)

N76-32899# California Univ., Livermore. Lawrence Livermore Lab.
ANALYSIS OF OPERATING SYSTEM SECURITY
Janet S. Chin 2 Dec. 1975 26 p refs Presented at the 1976 Natl. Computer Conf., New York, 7-10 Jun. 1975
(Contract W-7405-eng-48; Proj. RISOS)
(UCRL-77555; Conf-7506113-1) Avail: NTIS HC $4.00

Much research has been directed at designing a secure operating system. The majority of present-day systems were not designed with security requirements as significant factors. As a result, these operating systems have been and continue to be compromised by system-knowledgeable programmers. The security problems in these systems can be dealt with only after they have been identified. A methodology developed to locate problem areas and to identify ways of compromising systems is described.
Author (ERA)

N76-32900# California Univ., Livermore. Lawrence Livermore Lab.
USER'S GUIDE TO THE OCTOPUS COMPUTER NETWORK (THE SHOC MANUAL)
Carl Schneider, Dave Thompson, and Gail Whitten 2 Jun. 1975 83 p refs Supersedes UCID-30048-Rev-1
(Contract W-7405-eng-48)
(UCID-30048-Rev-2; UCID-30048-Rev-1) Avail: NTIS HC $5.00

This guide explains how to enter, run, and debug programs on the Octopus network. It briefly describes the network's operation, and directs the reader to other documents for further information. It stresses those service programs that will be most useful in the long run; quick methods that have little flexibility are not discussed. The Octopus timesharing network gives the user access to four CDC 7600 computers and a broad array of peripheral equipment, from any of 800 remote terminals.
Author (ERA)

N76-32901# California Univ., Livermore. Lawrence Livermore Lab.
TMDS MANUAL
J. C. Fletcher 9 Feb. 1976 42 p
(Contract W-7405-eng-48)
(UCID-30118) Avail: NTIS HC $4.00

The Television Monitor Display System (TMDS) is an octopus subnetwork that supports up to 512 television monitor devices. These devices enable the user to display both text and graphic pictures. This manual explains how the user interacts with TMDS, describes the format of display information, and also covers various aspects of TMDS operation of interest to the system programmer.
Author (ERA)

N76-32902# National Bureau of Standards, Washington, D.C. Computer Systems Engineering Div.
INTERPRETATION OF DATA IN THE NETWORK MEASUREMENT SYSTEM Final Technical Note
Shirley Watkins Ward and Marshall D. Abrams Mar. 1976 50 p refs
(PB-252680/4; NBS-TN-897) Avail: NTIS HC $4.00 CSCL 09B

The Network Measurement System (NMS) represents an implementation of a new approach to the performance measurement and evaluation of computer network systems and services. The interpretation of data within the NMS is described. These data were acquired by the Network Measurement Machine (NMM) component of the NMS and are then interpreted by a Data Analysis Package (DAP), which produces meaningful information concerning the quality of network service delivered to interactive terminal users as well as a characterization of user demands and network communication facility utilization. The flow of data from the time of capture by the minicomputer based NMM through the several phases of modeling and structuring in the DAP is described along with the statistical treatment of the data which provides quantitative measures of various aspects of network performance.
GRA

N76-32903# United Technologies Research Center, East Hartford, Conn.
KEY CONTROL ASSESSMENT FOR LINEAR MULTIVARIABLE SYSTEMS Final Technical Report
Gerald J. Michael and Gene S. Sogliero Jan. 1976 51 p refs
(Contract F44620-75-C-0027; AF Proj. 9769)
(AD-A023253; UTRC-R76-942042; AFOSR-76-0154TR) Avail: NTIS CSCL 12/1

Analytical procedures for a priori assessment of key control variables in linear multi-input dynamic systems have been developed and evaluated. These procedures result in explicit, quantitative measures of control influence which allow a control designer to assess the relative importance of all control variables prior to actual feedback control design. In this manner the designer can select for dynamic modulation those controls which have the strongest influence on system dynamic response. The approach employed to develop key control assessment methodology is based on a modal interpretation of multivariable system dynamics. This approach is particularly well-suited here since mathematical expressions relating the coupling of each control variable into each mode of the system can be explicitly derived. These mathematical expressions provide important insight into the relationships among output variables, modes, control variables and the quadratic performance index used to generate linear multivariable feedback control. These relationships were used to define quantitative measures of relative control influence for both open-loop and closed-loop control situations.
GRA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N76-32904 Purdue Research Foundation, Lafayette, Ind.
COMBINATORIAL PROBLEMS IN PATTERN RECOGNITION Ph.D. Thesis
Patrenahalli Mariappa Narendra 1975 110 p
Avail: Univ. Microfilms Order No. 76-20489

Combinatorial search problems in pattern recognition are investigated. A new optimal feature subset selection algorithm based on branch and bound techniques is developed to select the best subset of m features from a set of n features. A clustering algorithm based on the branch and bound method of combinatorial optimization is developed. This algorithm determines the globally optimum classification and is computationally efficient. Computer experiments demonstrate the efficiency of the algorithm. A noniterative, graph theoretic approach to nonparametric cluster analysis is presented. The resulting algorithm is governed by a single scalar parameter, requires no starting classification, and is capable of determining the number of clusters. An asymptotic analysis of the algorithm is also presented. This analysis indicates that the algorithm behaves as a valley seeking algorithm in the large sample case. Thus, an equivalence is established between the unimodal set approach and the valley seeking approach to cluster analysis.
Dissert. Abstr.

N76-32905 Purdue Univ., Lafayette, Ind.
WEB GRAMMARS AND THEIR APPLICATION TO PATTERN RECOGNITION Ph.D. Thesis
John Marvin Brayer 1975 292 p
Avail: Univ. Microfilms Order No. 76-21089

The hierarchy of web grammars is defined. Regular and regular-linear web grammars are defined for the first time. The properties of regular-linear and context free web grammars are studied. Web grammars are compared to other existing grammatical formalisms such as plex grammars, graph grammars and push-out constructions. The string grammar hierarchy is shown to be a compatible, topologically restricted subclass of web grammars. Regular-linear web grammars are proved equivalent to regular string grammars. Automata for these languages are studied. Existing grammatical inference procedures are also reviewed and where appropriate, extended to apply to web

grammars. Web grammars are then applied to model the land use pattern in an ERTS picture of Indianapolis, Indiana. A web grammar model is developed and used to improve the accuracy of the classification and to detect some new classes. One example of the proposed grammatical inference approach is demonstrated. Dissert. Abstr.

N76-32906 Purdue Univ., Lafayette, Ind.
TRANSITION NETWORKS FOR PATTERN RECOGNITION Ph.D. Thesis
Su May Chou 1975 190 p
Avail: Univ. Microfilms Order No. 76-20439

Transition networks and their relationships to grammars of Chomsky's hierarchy are studied. The modified Earley's parsing algorithm for transition network grammars is discussed. The stochastic and error correcting versions of transition networks are also presented. The approach of stochastic error, correcting transition network analysis is proposed to solve the problem of noise and distortion in syntactic pattern recognition. Finally, an approach to the inference of transition networks is proposed. The inference on the probability assignment over the arcs of stochastic transition networks is also discussed. The inference techniques are illustrated by examples. Dissert. Abstr.

N76-32907# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
AUTOMATIC PATTERN RECOGNITION IN A MULTI-SENSOR ENVIRONMENT Final Scientific Report, Mar. 1971 - Dec. 1975
Kenneth J. Breeding 27 Jan. 1976 30 p refs
(Grant AF-AFOSR-2048-71)
(AD-A023127; AFOSR-76-0401TR) Avail: NTIS CSCL 09/2

The primary objectives of this research effort have been threefold: (1) The development of pattern recognition algorithms applicable to three-dimensional targets such as aircraft, (2) The investigation of target acquisition and tracking procedures, and (3) The development of hardware/software to implement these algorithms in real time. GRA

N76-32908# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
IMAGE ANALYSIS AND MODELING
Paul A. Wintz and T. S. Huang 27 Jan. 1976 109 p refs
(Contract F30602-75-C-0150; ARPA Order 2893)
(AD-A023633; RADC-TR-76-76) Avail: NTIS CSCL 09/2

This report summarizes the results of the research program on Image Analysis and Modeling supported by the Defense Advanced Research Projects Agency. The objective is to achieve a better understanding of image structure and to use this knowledge to develop improved image models for use in image analysis and processing tasks such as information extraction, image enhancement and restoration, and coding. The ultimate objective of this research is to form a basis for the development of technology relative to military applications of machine extraction of information from aircraft and satellite imagery of the earth's surface. GRA

N76-32909# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A SYSTEM FOR REPRESENTING AND USING REAL WORLD KNOWLEDGE M.S. Thesis
Scott E. Fahlman May 1975 86 p refs
(Contract N00014-75-C-0643)
(AD-A021178; AIM-331) Avail: NTIS CSCL 06/4

This paper describes progress to date in the development of a system for representing various forms of real-world knowledge. The knowledge is stored in the form of a net of simple parallel processing elements, which allow certain types of deduction and set-intersection to be performed very quickly and easily. It is claimed that this approach offers definite advantages for recognition and many other data-accessing tasks. Suggestions are included for the application of this system as a tool in vision, natural-language, etc. Author (GRA)

N76-32910# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SPEECH UNDERSTANDING SYSTEMS Quarterly Technical Progress Report, 30 Oct. 1975 - 31 Jan. 1976
William A. Woods, M. Bates, G. Brown, B. Bruce, C. Cook, L. Gould, J. Kloustad, J. Makhoul, B. Nash-Webber, and R. Schwartz Feb. 1976 110 p refs
(Contract N00014-75-C-0533; ARPA Order 2904)
(AD-A022592; BBN-3240; QTPR-5) Avail: NTIS CSCL 09/4

This project is an effort to develop a continuous speech understanding system which uses syntactic, semantic and pragmatic support from higher level linguistic knowledge sources to compensate for the inherent acoustic indeterminacies in continuous spoken utterances. These knowledge sources are integrated with sophisticated signal processing and acoustic-phonetic analysis of the input signal, to produce a total system for understandiing continuous speech. The system contains components for signal analysis, acoustic parameter extraction, acoustic-phonetic analysis of the signal, phonological expansion of the lexicon, lexical matching and retrieval, syntactic analysis and prediction, semantic analysis and prediction, pragmatic evaluation and prediction, and inferential fact retrieval and question answering, as well as synthesized text or spoken output. GRA

N76-32911# Texas Univ., Austin. Center for Cybernetic Studies.
CONSTRAINED INFORMATION THEORETIC CHARACTERIZATIONS IN CONSUMER PURCHASE BEHAVIOR
A. Charnes, W. W. Cooper, and D. B. Learner Jul. 1975 21 p refs
(Contracts N00014-75-C-0569; N00014-75-C-0621; NR Proj. 047-021)
(AD-A022690; CCS-252) Avail: NTIS CSCL 09/4

The analysis called SAND DABS which has had a long history of use in consumer purchase behavior (including brand switching) at MRCA and elsewhere, is here given a constrained information theoretic characterization. This is made possible by recent developments in optimization and duality which are precise and general. That is, these developments generalize the classical relations between information theory and statistics as previously established in very precise forms by Kullback-Leibler (and others). Contacts with geometric programming in an extended form along with other recent developments in optimization and duality are also supplied and a way is thereby opened for unifying many apparently separate approaches to market analysis. Author (GRA)

N76-32912# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SENSITIVITY OPERATORS AND ASSOCIATED SYSTEM CONCEPTS FOR LINEAR DYNAMIC SYSTEMS Ph.D. Thesis
J. Gary Reid Dec. 1975 216 p refs
(AD-A023342; DS/EE/75-4) Avail: NTIS CSCL 12/1

Output parameter sensitivity for linear dynamic systems is treated in an operator framework. Parameter sensitivity is derived for a general linear system defined as the sum of linear operators on the initial state and control input. The sensitivity-related properties of insensitivity, sensitivity controllability, parameter identification and identifiability, and optimal control design for both minimum sensitivity and improved identification are then dealt with in terms of the sensitivity operators and their adjoints. This theoretical foundation is applied to give fundamental descriptions of the parameter sensitivities in linear ordinary differential equation systems. The discussion focuses on linear time-invariant systems where a new algebraic representation of the parameter sensitivities is obtained. GRA

N76-32913# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
VARIATIONS ON THE NONLINEAR NYQUIST CRITERIA Interim Report
R. A. DeCarlo and R. Saeks Aug. 1975 7 p refs Repr. from the Proceedings of the 18th Midwest Symp. on Circuits and Systems, Montreal, 11-12 Aug. 1975 p 116-119
(Grant AF-AFOSR-2631-74; AF Proj. 9749)
(AD-A023272; AFOSR-76-0362TR) Avail: NTIS CSCL 12/1

Classically the study of closed loop system stability is approached through frequency domain techniques, e.g., the Nyquist and Hurwitz criteria. In the nonlinear case frequency response is not well-defined; however, one of the authors has recently shown that the spectrum of a nonlinear operator can be used in lieu of the usual Nyquist plot as a means of generalizing

the Nyquist criteria to the nonlinear case. Through some perturbation techniques we characterize in this paper the stability of nonlinear operators by the more accessible 'approximate point spectrum' as opposed to the entire spectrum.
Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N76-32914 Dartmouth Coll., Hanover, N.H.
INDUCTION TECHNIQUES AND PERIODICITY IN CLIFFORD ALGEBRAS Ph.D. Thesis
Bruce Haven Edwards 1976 52 p
Avail: Univ. Microfilms Order No. 76-19858

Aspects of the structure theory of Clifford algebras are investigated. Induction techniques are first established and the Clifford algebra and even Clifford algebra of similar quadratic spaces are investigated. As a consequence of a proof that the even Clifford algebra is invariant under similarities, it is shown that the even Clifford group has that same property. Theorems are proved concerning the invariance of the total Clifford algebra under similarities. There follows a classification, theorems for quadratic spaces of dimension four and discriminant one, and finally a proof of the fact that the even Clifford group of a four-space is a normal subgroup of the group of units of the even Clifford algebra. The periodic nature of the Clifford algebra C(V) and the even Clifford algebra C+(V) is then discussed. Finally, the structures of the Clifford algebra and the even Clifford algebra are determined for certain quadratic spaces.
Dissert. Abstr.

N76-32915 Michigan Univ., Ann Arbor.
THE FINITE ELEMENT APPROXIMATION OF EIGENVALUE PROBLEMS INVOLVING NON-COMPACT DIFFERENTIAL OPERATORS Ph.D. Thesis
Wendell Holmes Mills, Jr. 1976 131 p
Avail: Univ. Microfilms Order No. 76-19197

Approximate eigensolutions are found to the differential eigenvalue problem, Lu = lambda x Mu where L is an elliptic partial differential operator and the solution operator L - 1 M, is not necessarily compact. Such elliptic problems are posed abstractly in the weak form. Under this formulation, the approximation method known as the finite element method is applied. The results concern the convergence and rate of convergence of the approximate solutions, (lambda sub h, u sub h) to the actual solutions (lambda, u). The results show that if the compactness assumption is replaced by certain weaker stability and approximability assumptions, the same optimal convergence results are obtained. The abstract results are applied to the separate hydrogen operator of quantum physics. The theory for this application is developed and computational results are shown to agree precisely with the mathematical theory. Dissert. Abstr.

N76-32916 North Carolina Univ., Chapel Hill.
NONLINEAR ANALYSIS OF SPHERICALLY INVARIANT PROCESSES AND ITS RAMIFICATIONS Ph.D. Thesis
Steel Tsu-Wei Huang 1975 108 p
Avail: Univ. Microfilms Order No. 76-20040

The structure of the nonlinear space of spherically invariant processes which constitute a natural generalization of Gaussian processes, was defined. Also defined were mutiple Wiener integrals for spherically invariant processes (and hence for Gaussian processes) thus generalizing the notion originally introduced for a Wiener process. An orthogonal decomposition of the nonlinear space and an integral representation for its L2-functionals, which is expressed in terms of multiple Wiener integrals, were obtained. These results were applied to nonlinear estimation and prediction theory, the nonlinear noise theory, and the equivalence of spherically invariant processes. Dissert. Abstr.

N76-32917 New York Univ., N.Y.
THE CRITICAL BEHAVIOR OF THE ANHARMONIC OSCILLATOR Ph.D. Thesis
David Isaacson 1976 75 p
Avail: Univ. Microfilms Order No. 76-19509

All the eigenvalues, eigenfunctions, and Schwinger functions of an ordinary differential operator are studied. It is shown that the scaling limit of the Schwinger functions equals the scaling limit of a one dimensional Ising model. Critical exponents are shown to equal critical exponents of the Ising model, while critical exponents of the renormalized theory are shown to agree with those of a harmonic oscillator. Dissert. Abstr.

N76-32918 New York Univ., N.Y.
HOMOGENIZATION OF LINEAR TRANSPORT PROBLEMS Ph.D. Thesis
Michael Williams 1976 92 p
Avail: Univ. Microfilms Order No. 76-19565

The physical theory of the forward and backward linear transport equations is discussed especially as it applies to a nuclear reactor. Asymptotic expansions are carried out for these equations in the presence of fast spatial heterogeneities where the small parameter is the mean free path which is comparable in size to a cell cross-section in a nuclear reactor. This process is called homogenization. Expansions are also carried out for reflecting and absorbing boundary conditions without fast spatial variation. The validity of the expansions is shown for the transport problem with Dirichlet data and periodic fast spatial variation in the absence of initial and boundary layers. For absorbing and reflecting boundary value problems without fast spatial dependence, the validity of the expansions with boundary layers is demonstrated for the Laplace transforms of the solutions. The limiting diffusion problem is calculated explicitly for a one-dimensional two velocity model with fast periodic spatial dependence. Dissert. Abstr.

N76-32919 Princeton Univ., N.J.
ASYMPTOTIC PROPERTIES OF ESTIMATES OBTAINED BY NONLINEAR OPTIMIZATION OR BY SOLVING NONLINEAR EQUATIONS Ph.D. Thesis
James E. Ertel 1975 68 p
Avail: Univ. Microfilms Order No. 76-20358

Some theorems are developed concerning the asymptotic properties of sums of dependent random variables. In addition, some examples of how these results can be applied to some common problems from robust estimation are presented. Finally, a theorem is proved which permits dimensional reduction for special forms of F (parameter to be estimated). This theorem and the Central Limit Theorem are applied to an optimization problem of fitting Lorentzian line spectra. Dissert. Abstr.

N76-32920 Texas A&M Univ., College Station.
USE OF FINITE ELEMENT METHODS IN SOLUTION OF OPTIMUM DISTRIBUTED PARAMETER SYSTEMS Ph.D. Thesis
Shyama Charan Tandon 1976 95 p
Avail: Univ. Microfilms Order No. 76-20633

The problem of designing an optimum distributed parameter system was studied. The necessary conditions for optimality were derived by applying the calculus of variation. Fundamental concepts pertaining to the solution of optimum distributed parameter systems by finite element methods were devised. It was demonstrated that methods can readily be applied to solve problems involving nonlinear Neumann boundary conditions.
Dissert. Abstr.

N76-32921 Purdue Univ., Lafayette, Ind.
ESTIMATION AND TESTS FOR UNKNOWN LINEAR RESTRICTIONS IN MULTIVARIATE LINEAR MODELS Ph.D. Thesis
John Douglas Healy 1975 130 p
Avail: Univ. Microfilms Order No. 76-20445

The classical multivariate linear regression model and the Potthoff-Roy model are discussed. The consistency of the estimators, asymptotic tests, and likelihood ratio test statistics are included. Dissert. Abstr.

N76-32922 Tulane Univ., New Orleans, La.
ESTIMATION IN A NON-STATIONARY MARKOV CHAIN Ph.D. Thesis
Janet Hughes Diem 1976 160 p
Avail: Univ. Microfilms Order No. 76-21408

Consider a time-continuous non-stationary Markov chain with finitely many states. The transition probabilities are determined by the so-called transition forces (or infinitesimal transition probabilities). Such a model finds applications in many medical and demographic studies, and since the transition forces give important information concerning the process, it is often of interest to estimate them. It is shown that the introduction of non-stationarity yields non-trivial conditions under which the maximum likelihood estimates do not exist. A method for evaluating these estimates (when they exist) is obtained and large sample properties are investigated. Asymptotically, the estimators are shown to exist and to enjoy certain optimal properties. Results of computer simulation of the process are tabulated, comparing the actual values of the forces with the corresponding estimates obtained by the method presented. Dissert. Abstr.

N76-32923 California Univ., Irvine.
THE NORM-DERIVATIONS IN BANACH SPACES AND GEOMETRIC APPLICATIONS Ph.D. Thesis
Theagenis John Abatzoglou 1976 87 p
Avail: Univ. Microfilms Order No. 76-19619

Given a real Banach space B and elements x, y epsilon B, the function: f(t) = norm of x + ty is considered. It is assumed that f is differentiable for all x, y and t such that x + t is not = zero, the norm of the Banach space is Gateaux differentiable. The concept of Gateaux derivative of the norm is used to obtain the explicit modulus of continuity for the minimum norm projection on closed subspaces. The Gateaux differentiability of the norm is also used to derive the geodesic equation on the sphere of a Banach space. Dissert. Abstr.

N76-32924# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
SOLUTION OF INTERFACE PROBLEMS BY HOMOGENIZATION, 3
Ivo Babuska Sep. 1975 31 p refs
(Contract AT(40-1)-3443)
(ORO-3443-56; TN-BN-827) Avail: NTIS HC $4.00

Homogenization is generalized to nonlinear differential equations. With previous results as a basis, a simplified proof is presented which holds for the nonlinear case. ERA

N76-32925# Maryland Univ., College Park.
MATHEMATICAL PROBLEMS OF COMPUTATIONAL DECISIONS IN THE FINITE ELEMENT METHOD
I. Babuska and W. Rheinboldt Dec. 1975 46 p refs
(Contract AT(40-1)-3443)
(ORO-3443-57; TR-426; NSF-OCA-GJ35568x-426) Avail: NTIS HC $4.00

The questions addressed here concern the effect of different mathematical formulations of the basic problem upon the results, the influence of the desired accuracy on the efficiency of the process, the selection and comparison of different types of elements, and for nonlinear problems the choice of efficient methods for solving the resulting finite-dimensional equations. In all cases, a consistent use of self-adaptive techniques is strongly indicated. Author (ERA)

N76-32926# California Univ., Berkeley. Lawrence Berkeley Lab.
GENERALIZED CONJUGATE GRADIENT METHOD FOR THE NUMERICAL SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS
Paul Concus, G. H. Golub (Stanford Univ., Calif.), and D. P. OLeary (Michigan Univ., Ann Arbor) Sep. 1975 28 p refs Presented at the Symp. on Sparse Matrix Computations, Argonne, Ill., 9 Sep. 1975
(Contract W-7405-eng-48)
(LBL-4604; Conf-750987-2; STAN-CS-75-533) Avail: NTIS HC $4.00

A generalized conjugate gradient method is considered for solving sparse, symmetric, positive-definite systems of linear equations, principally those arising from the discretization of boundary value problems for elliptic partial differential equations. The method is based on splitting off from the original coefficient matrix a symmetric, positive-definite one that corresponds to a more easily solvable system of equations, and then accelerating the associated iteration using conjugate gradients. Optimality and convergence properties are presented, and the relation to other methods is discussed. Several splittings for which the method seems particularly effective are also discussed; and for some, numerical examples are given. Author (ERA)

N76-32927# Los Alamos Scientific Lab., N.Mex.
INTEGRATION METHODS FOR UNCOUPLED AND COUPLED THERMOELASTIC PROBLEMS
Roy A. Axford Aug. 1975 22 p refs
(Contract W-7405-eng-36)
(LA-6071) Avail: NTIS HC $4.50

A unified method based upon a single quadrature logic can be used to compute transient thermal stresses in the uncoupled, quasi-static; the uncoupled; and the coupled, thermoelastic approximations. Instantaneous heat fluxes at the boundaries of finite media lead to infinite surface stresses, but these singularities can be removed by using instantaneous volumetric heat sources spread over thin regions adjacent to a surface. Author (ERA)

N76-32928# Illinois Univ., Urbana. Dept. of Computer Science.
BLOCK ENVELOPE SOLUTION OF FINITE DIFFERENCE SYSTEMS
A. H. Sherman Nov. 1975 21 p refs
(Contracts AT(11-1)-2383; N00014-67-A-0097-0016)
(COO-2383-0026; UIUCDCS-R-75-765) Avail: NTIS HC $3.50

A description is given of an envelope-oriented block Gaussian elimination method for solving linear systems arising from the use of five-point finite-difference approximations on n x n square grids. A significant improvement on the costs of ordinary band and envelope methods was demonstrated, but, for moderate values of n (say, n less than or equal to 50), the band and envelope methods are superior. Author (ERA)

N76-32929# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
NUMERICAL SOLUTION OF HELMHOLTZ'S EQUATION BY THE CAPACITANCE MATRIX METHOD
O. Widlund and W. Proskurowski (Royal Inst. of Technol., Stockholm) Nov. 1975 104 p refs Sponsored in part by the Swedish Science Research Council
(Contract E(11-1)-3077; Grant NSF GP-35747)
(COO-3077-99) Avail: NTIS HC $5.50

The computer solution of the Helmholtz equation is discussed. Problems can be treated on bounded regions which do not allow for separation of variables. The topics treated are as follows: certain results from classical potential theory, the imbedding of discrete Poisson problems, a capacitance matrix method for the Dirichlet case, a capacitance matrix method for the Neumann case, the Fourier-Toeplitz method and the fast generation of the capacitance matrix, the conjugate gradient method, previous work on capacitance matrix methods, numeral experiments, and outline of a computer program for the numerical solution of the interior Helmholtz equation in two variables with the Dirichlet and Neumann boundary conditions by finite difference methods. ERA

N76-32930# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
MODELS, TRANSFORMATIONS OF SCALE, AND WEIGHTING Final Report
John Mandel Apr. 1976 13 p refs Repr. from J. Quality Technol., v. 8, no. 2, Apr. 1976 p 86-97
(PB-252776/0) Avail: NTIS HC $3.50 CSCL 12A

A realistic model is an indispensable prerequisite to any meaningful data analysis. Since most common statistical procedures are based on models involving specific assumptions, such as homoscedasticity or absence of certain interactions, it has become current practice to transform the scale of the data in the hope of achieving conformance with these assumptions. It is suggested that this approach is logically unsatisfactory. The estimates of the pertinent variances, in any scale chosen by the user of the data, should be independent of the scale in which the statistical analysis was performed. The model should be flexible enough to allow for a realistic representation of the physical reality underlying the data. GRA

N76-32931# Naval Research Lab., Washington, D.C.
A BINARY ARITHMETIC FOR THE FERMAT NUMBER TRANSFORM
Lawrence M. Leibowitz 18 Mar. 1976 18 p refs
(AD-A023061; NRL-7971) Avail: NTIS CSCL 09/4

The number theoretic transform and the use of moduli of the form of the tth Fermat number F sub t = 2 sup b + 1, b = 2 sup t, are reviewed. A binary arithmetic that permits the exact computation of the Fermat number transform is described. This technique involves arithmetic in a binary code corresponding to the simplest one of a set of code translations from the normal binary representation of each integer in the ring of integers modulo F sub t. GRA

N76-32932# Alabama State Univ., Montgomery.
APPLICATIONS OF ORDERING RELATIONS Final Report, 1 Jul. 1974 - 30 Jun. 1975
Kim Ki-Hang Butler 10 Mar. 1976 8 p refs
(Grant DAHC04-74-G-0232)
(AD-A022566; ARO-12749.2-M) Avail: NTIS CSCL 12/1

The asymptotic forms of powers of binary relations are investigated in terms of Boolean matrices. GRA

N76-32933# Wisconsin Univ., Madison. Mathematics Research Center.
UPPER AND LOWER BOUNDS FOR SOLUTIONS OF LINEAR OPERATOR PROBLEMS WITH UNILATERAL CONSTRAINTS
W. D. Collins Jan. 1976 27 p refs
(Contract DAAG29-75-C-0024)
(AD-A022747; MRC-TSR-1592) Avail: NTIS CSCL 12/1

Dual extremum principles characterizing the solutions of problems for a positive-definite self-adjoint operator on a Hilbert space which involve unilateral constraints are formulated using a Hilbert space decomposition theorem due to Moreau. Various upper and lower bounds involving the solutions to subsidiary problems with less restrictive conditions than the solution to the original problem. GRA

N76-32934# Wisconsin Univ., Madison. Mathematics Research Center.
Nth ORDER ORDINARY DIFFERENTIAL SYSTEMS UNDER STIELTJES BOUNDARY CONDITIONS
Allan M. Krall and Richard C. Brown Dec. 1975 29 p refs
(Contract DAAG29-75-C-0024)
(AD-A022745; MRC-TSR-1581) Avail: NTIS CSCL 12/1

This article gives several substantial simplifications and refinements to the calculation of the adjoint linear relation of a nondensely defined ordinary differential operator on the Banach space L(sup p, sub m)closed interval(0,1) whose domain is in part determined by Stieltjes boundary conditions. The adjoint relation involves not only the formal differential adjoint, but in addition, two other parametric terms, one of which can be specified in terms of end point boundary conditions. Green's formula is also derived. The results obtained can be applied to the study of optimality properties of certain spline function approximations and to operators with Stieltjes type boundary conditions which arise in the control theory of hyperbolic partial differential equations. GRA

N76-32935# Wisconsin Univ., Madison. Mathematics Research Center.
DERIVATIVES, DIFFERENCES, MULTIPLE FOURIER KERNELS
D. B. Liu and L. C. Young Jan. 1976 36 p refs
(Contract DAAG29-75-C-0024; Grant NSF GP-27211)
(AD-A022744; MRC-TSR-1578) Avail: NTIS CSCL 12/1

Identities and inequalities for Fourier kernels and for difference operators are related to a geometric series identity. The resulting machinery is applied to obtain, in the approximation theory for ordinary or partial derivatives of any order, necessary and sufficient conditions in place of classical sufficient conditions. Alternative formulations are given in terms of Tauberian Theorems, and in terms of Schwartz distributions. The results are achieved by making use, as in L. C. Young's papers on Stochastic integrals and the like, of pairs of estimate functions in place of the classical higher moduli of continuity. GRA

N76-32936# Wisconsin Univ., Madison. Mathematics Research Center.
THE APPLICATION OF LINEAR MULTISTEP METHODS TO SINGULAR INITIAL VALUE PROBLEMS
Frank R. deHoog (Calif. Univ., Los Angeles) and Richard Weiss Feb. 1976 33 p refs
(Contract DAAG29-75-C-0024; Grant NSF MPS-72-00381)
(AD-A022743; MRC-TSR-1576) Avail: NTIS CSCL 12/1

A theory for linear multistep schemes applied to the initial value problem for a nonlinear first order system of differential equations with a singularity of the first kind is developed. Predictor-corrector schemes are also considered. The specific examples given are systems derived from partial differential equations in the presence of symmetry. GRA

N76-32937# Wisconsin Univ., Madison. Mathematics Research Center.
MODELING OF MULTIPLE TIME SERIES BY THE METHOD OF SUCCESSIVE ORTHOGONALIZATION
M. S. Phadke Jan. 1976 38 p refs
(Contract DAAG29-75-C-0024; Grant NSF GP-40381)
(AD-A022742; MRC-TSR-1561) Avail: NTIS CSCL 12/1

This paper concerns the modeling of covariance stationary multiple time series by the method of successive orthogonalization. Fundamental to the method of successive orthogonalization is the factorization of the spectral density matrix which results into a unique triangular two sided moving average model (TTSMA model). The proposed method of modeling multiple time series is to build (specify, estimate and check) a TTSMA model for a given set of observations. Any other form of the model, say the canonical model, can be obtained by an appropriate transformation. GRA

N76-32938# Illinois Univ., Urbana. Electromagnetics Lab.
DIGITAL DECONVOLUTION: IMAGE SAMPLING AND RESTORATION TECHNIQUES
Daniel J. Udovic and Raj Mittra Oct. 1975 116 p refs
(Grant DAHC04-74-G-0113; ARO Proj. P-12049-E)
(AD-A022455; UIEL-75-5; UILU-ENG-75-2548; ARO-12049.6-EL) Avail: NTIS CSCL 12/1

The finite length digital deconvolution problem is formulated and discussed in terms of modern optimization theory. The ill-conditioned nature of deconvolution is identified and classic deconvolution operators are examined in terms of their respective effectiveness and ease of implementation. Continuous deconvolution filters that are optimal in terms of minimum variance and solution smoothness are derived. These filters contain digital counterparts which can be obtained by means of conventional frequency sampling techniques. Quantization and frequency-aliasing are identified as characteristic noise sources of digital deconvolution and analyzed in terms of their respective corrupting effects upon accurate optical signal estimation. Three approaches for eliminating frequency-aliasing error are discussed. A multiple intensity measurement technique for determining the magnitude and phase of complex optical wavefronts by means of a coherent optics-microprocessor hybrid system is developed. A picture-shift sampling scheme is proposed for effectively increasing picture sampling resolution without requiring additional computer core. A method is developed, based upon this scheme and incoherent light illumination, for performing continuous lowpass filtering. GRA

N76-32939# Sperry Rand Research Center, Sudbury, Mass.
INTEGRAL EQUATION SOLUTION Final Technical Report, 30 Sep. 1974 - 21 Oct. 1975
C. L. Bennett and R. M. Hieronymus Griffiss AFB, N. Y. RADC Mar. 1976 96 p refs
(Contract F30602-75-C-0040; AF Proj. 4506)
(AD-A023204; RADC-TR-76-59) Avail: NTIS CSCL 12/1

The space-time integral equation approach is extended to the problem of scattering from surfaces with fins attached. The hybrid integral equation solution technique is used in which an H-field integral equation for the surface and an E-field integral equation for the fin are solved simultaneously for the unknown current by marching on in time. Smoothed impulse responses are obtained using this technique for a right circular cylinder with four fins attached at numerous aspect angles. These computed results compare well with measurements taken on

the time domain scattering range. The impulse response augmentation technique for obtaining the total impulse response and frequency response over the entire spectrum is extended to rectangular flat plates, right circular cylinders with oblique incidence, and cylinders with fins at axial incidence. Impulse responses are obtained and presented for a square flat plate at a number of incidence angles for both TE and TM polarizations. Results are also presented for a right circular cylinder with a length to diameter ratio of 2:1 at a number of incidence angles for both TE and TM polarizations. Finally, an estimate of the impulse response of a cylinder with fins attached was obtained for the case of axial incidence. Author (GRA)

N76-32940# California Univ., Los Angeles. School of Engineering and Applied Science.
STABILITY AND INSTABILITY CONDITIONS FOR NONLINEAR EVOLUTIONAL EQUATIONS IN HILBERT SPACES
P. K. C. Wang Feb. 1976 28 p refs
(Grant AF-AFOSR-2662-74; AF Proj. 9752)
(AD-A023220; UCLA-ENG-7620; AFOSR-76-0399TR) Avail: NTIS CSCL 12/1

Sufficient conditions for stability, global asymptotic stability and explosive instability are established for a class of nonlinear evolutional equations defined in Hilbert spaces by using certain relations between an abstract function and its Gateaux differential. These results are applied to specific forms of nonlinear evolutional equations arising from physics, in particular, a finite-dimensional system of complex ordinary differential equations, functional differential equations, and systems of complex partial differential equations describing nonlinear diffusion or wave phenomena.
GRA

N76-32369 Illinois Univ., Chicago.
NONLINEAR ANALYSIS DESCRIPTION AND NUMERICAL STABILITY
Ted Belytschko *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 537-562 refs (For availability see N76-32339 23-31)

N76-32371 Texas A&M Univ., College Station.
EIGENVALUE EXTRACTION
Robert A. Wilke and James A. Stricklin *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 579-601 refs (For availability see N76-32339 23-31)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N76-32941 Carnegie-Mellon Univ., Pittsburgh, Pa.
THE ANALYSIS OF DATA FROM A BIVARIATE NORMAL DISTRIBUTION WITH MISSING OBSERVATIONS Ph.D. Thesis
Russell Edwin Hannula 1976 201 p
Avail: Univ. Microfilms Order No. 76-19326

The problem of analyzing data from a bivariate normal distribution when there are observations missing on either or both variables is considered from a Bayesian point of view. The goal is to derive the posterior means and variances for the parameters of the bivariate normal and the values of the missing data. The approach to the problem is to condition the distribution of the parameters on the values of the missing data and then derive the marginal posterior distribution of the missing data. The moments for the missing data follow from this marginal posterior, while those for the parameters are derived through conditional expectation. In the case where there are observations missing on only one variable, the marginal posterior of the missing data will be a multivariate student t distribution. When observations are missing on both variables, the marginal posterior distribution of the missing data assumes a mathematically intractable form. Dissert. Abstr.

N76-32942 New York Univ., N.Y.
A STATISTICAL ANALYSIS OF INFORMATION PROCESSING USING MULTIPLE MASKING IN A COMPUTERIZED VISUAL PARADIGM Ph.D. Thesis
Leonard Presby 1974 119 p
Avail: Univ. Microfilms Order No. 76-19607

The effects upon multiple visual masking of variations in mask position, frequent and infrequent words, and on time are studied. Results are shown in the form of psychophysical curves, tables, and outcomes of statistical tests. The experiment is run with the aid of a PDP -8E digital computer-driven cathode ray tube (CRT) display. Stimulus displays, consisting of five letter words are flashed on the CRT, one word at a time, immediately followed by a multiple mask, in one of six positions, to subjects who are instructed to record immediately, the word or letters seen. Half of the subjects are presented with frequent words and the other half with infrequent words. A 2x6x4 experimental design is used with frequent words or not frequent words at two levels, mask position at six levels, and on time at four levels, either 5, 10, 20 or 35 msec. Results show both word frequency and on time are highly significant factors (.001 level) whereas the masking position is not. Dissert. Abstr.

N76-32943 Purdue Univ., Lafayette, Ind.
FEATURE EXTRACTION IN HIGH-DIMENSIONAL VECTOR SPACES Ph.D. Thesis
George Vernon Sherman 1975 232 p
Avail: Univ. Microfilms Order No. 76-20399

The problem of extracting features from a large set of raw measurements is considered. The raw measurements are assumed to adequately describe some phenomenon in question. However, often the raw measurements are very correlated and hence redundant. In such cases, a relatively small set of features can usually be derived from the raw measurements and can thus perform the description more economically. Four types of phenomenon description are considered. In the first type, the singular value decomposition (SVD) is used to generate orthonormal basis matrices which are efficient for representing random pictures. In the second type, the SVD is used in a 2-dimensional version of the subspace method to classify random pictures. In the third type, the SVD is used to reduce the number of training samples in a population without altering the first and second moments. Finally in the fourth type of phenomenon description, the SVD is used to simplify the Weiner-filtering operation.
Dissert. Abstr.

N76-32944# Materials Research Labs., Maribyrnong (Australia).
FRAGMENTATION DATA ANALYSIS. 2: COMPUTER PROGRAM FOR FRAGMENTATION ANALYSIS AND EFFECTS OF ERRORS ON MASS AND NUMBER DISTRIBUTIONS
A. J. Bedford and P. Krauklis May 1976 48 p
(Rept-666) Avail: NTIS HC $4.00

A semi-automatic data acquisition technique is used to produce an accumulating list of fragment masses, and this mass listing is introduced into a computer which is programmed to produce a series of mass groups and to give the number and mass of fragments in each of those groups. This information is used to calculate parameters associated with the Mott or Payman equations; the corresponding fragment number or mass distribution is then derived. Possible errors in raw fragmentation data which may be introduced during collection of fragments after an experiment are investigated to examine the effects they might have on Mott distributions. Author

N76-32945# Atomic Energy Research Establishment, Harwell (England).
INTRODUCTION TO WEIBULL STATISTICS
P. M. Braiden Dec. 1975 20 p refs
(AERE-R-7165) Avail: ERDA Depository Libraries HC $3.50; U.K. £1.00

Weibull statistics are described with particular reference to the analysis of data obtained from mechanical tests on brittle materials. The basic equations are all derived from principles and the construction and use of Weibull Probability Graphs are described in detail. Finally some typical strength tests are analyzed and compared from a statistical approach.
Author (ERA)

N76-32946# Kentucky Univ., Lexington. Dept. of Mathematics.

SYMPOSIUM ON STOCHASTIC SYSTEMS Final Report, 1 Apr. 1975 - 31 Mar. 1976
Roger Wets Jan. 1976 26 p refs Conf. held in Lexington, Kentucky 10-14 Jun. 1976
(Grant NSF MPS-75-06590)
(PB-252368/6; NSF/ERG-76-3) Avail: NTIS HC $3.50 CSCL 12B

The basic goal of the conference was to bring together researchers working in the somewhat loosely defined area of stochastic systems. For some time there has been an awareness that many of the techniques used in the analysis and optimization of stochastic systems had many connections. This conference was the first serious attempt at bringing together researchers working in related fields but who usually do not move in the same circles. There were a number of speakers who dealt with such topics as energy models, computer networks, economics, population genetics, etc. GRA

N76-32947# Naval Underwater Systems Center, New London, Conn.
APPROXIMATIONS FOR STATISTICS OF COHERENCE ESTIMATORS
Albert H. Nuttall and G. Clifford Carter 9 Mar. 1976 42 p refs
(ZR00001)
(AD-A022845; NUSC-TR-5291) Avail: NTIS CSCL 12/1

Approximations for the Bias, variance, and mean-square error of estimators of the magnitude-squared coherence and magnitude coherence are presented. The approximations are accurate for all values of true coherence and over the practically useful range of N, where N is the number of averages employed in the coherence estimators. Author (GRA)

N76-32948# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ON ROBUST SEQUENTIAL CONFIDENCE INTERVALS
Raymond J. Carroll 1976 16 p refs
(Grant AF-AFOSR-2796-75; AF Proj. 9769)
(AD-A023281; AFOSR-76-0323TR) Avail: NTIS CSCL 12/1

The comparison in another paper of sequential confidence intervals of fixed length proposed by Chow and Robbins and Serfling and Wackerly are extended to include robust stopping rules based on M-estimators. It is found that a difference in the asymptotic variances exists, a phenomenon not observed in the previous paper. A method is given which makes the approach computationally feasible. GRA

N76-32949# North Carolina Univ., Chapel Hill. Dept. of Statistics.
COMPLETENESS COMPARISONS AMONG SEQUENCES OF SAMPLES
Norman L. Johnson Feb. 1976 24 p refs
(Grant DAHC04-74-C-0030)
(AD-A022614; MIMEO-SER-1056; ARO-11959.6-M) Avail: NTIS CSCL 12/1

It is assumed that two parallel sequences of sets of sample values are available and it is known that one is uncensored, though it may not be known which one. Procedures are developed for deciding which sequence is censored, or whether a specific sequence is censored. Distribution-free procedures, as well as procedures based on knowledge of population distributions, are obtained. Author (GRA)

N76-32950# North Carolina Univ., Chapel Hill. Dept. of Statistics.
A WEAK INVARIANCE PRINCIPLE WITH APPLICATIONS TO DOMAINS OF ATTRACTION Interim Report
Gordon Simons and William Stout (Ill. Univ., Urbana-Champaign) Nov. 1975 44 p refs Sponsored in part by NSF
(Grant AF-AFOSR-2796-75; AF Proj. 9769)
(AD-A023297; MIMEO-SER-1044; AFOSR-76-0403TR) Avail: NTIS CSCL 12/1

An elementary probabilistic argument is given which establishes a 'weak invariance principle' which in turn implies the sufficiency of the classical assumptions associated with the weak convergence of normed sums to stable laws. The argument, which uses quantile functions (the inverses of distribution functions), exploits the fact that two random variables X = F sup(-1)(U) and Y = G sup(-1)(U) are, in a useful sense, close together when F and G are, in a certain sense, close together. Here U denotes a uniform variable on (0,1). Byproducts of the research are two alternative characterizations for a random variable being in the domain of partial attraction to a normal law and some results concerning the study of domains of partial attraction. GRA

N76-32951# Florida State Univ., Tallahassee. Dept. of Statistics.
CHARACTERIZATION OF DISTRIBUTIONS BY LARGE DEVIATION RATES
J. Sethuraman Feb. 1976 9 p refs
(Grant DAHC04-74-G-0188)
(AD-A022612; FSU-Statistics-M335; ARO-10530.20-M; TR-15) Avail: NTIS CSCL 12/1

The exponential rate of convergence to zero of large deviation probabilities of the mean of independent and identically distributed random variables is well known. In this note, it is shown that this large deviation rate completely determines the common distribution. This feature becomes noteworthy when contrasted with the fact that the limits of the probabilities of ordinary and moderate deviations of the mean depend very little on the common distribution. GRA

N76-32952# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ON THE SERFLING-WACKERLY ALTERNATE APPROACH Interim Report
Raymond J. Carroll Feb. 1976 22 p refs
(Grant AF-AFOSR-2796-75; AF Proj. 9769)
(AD-A023282; Mimeo-Ser-1052; AFOSR-76-0324TR) Avail: NTIS CSCL 12/1

For the problem of fixed-length interval estimation of the mean and median, the limiting distributions of the stopping rules recently introduced by Serfling and Wackerly are compared to those of Chow and Robbins as both the non-coverage probability alpha and interval length d converge to zero. The procedures based on the sample mean differ in the centering constants, while those based on the sample median also differ in the scaling constants. GRA

N76-32953# Maryland Univ. Baltimore County, Baltimore. Div. of Mathematics and Physics.
EXPONENTIAL FOURIER DENSITIES AND OPTIMAL ESTIMATION AND DETECTION ON THE CIRCLE Mathematics Research Report
James Ting-Ho Lo Jan. 1976 24 p refs
(Grant AF-AFOSR-2671-74; AF Proj. 9769)
(AD-A023196; MRR-76-1; AFOSR-76-0182TR) Avail: NTIS CSCL 12/1

A new representation called an exponential Fourier density, of a probability density on a circle, S(1) is introduced. It is shown that a density on S(1) can be approximated by such a representation as closely as desired in the space of square-integrable functions on S(1). The exponential Fourier densities have the desirable feature of being closed under the operation of taking conditional distributions. Facilitated with it, finite-dimensional, recursive, and optimal estimation and detection schemes are derived for some simple models including a FSK communication system. Author (GRA)

N76-32954# Wyoming Univ., Laramie. Statistics Lab.
THE BIAS IN THE ROOTS OF SAMPLE COVARIANCE MATRICES
Robert K. Smidt and Lyman L. McDonald Feb. 1976 14 p refs
(Contract N00014-75-C-0515; NR Proj. 042-310)
(AD-A023490; S-1976-547; RP-105) Avail: NTIS CSCL 12/1

Many statistical techniques involve the use of the roots of sample covariance matrices, and in general, the roots of Wishart matrices. Any bias in these roots should be taken into account when these methods are employed. It is demonstrated analytically that for certain cases, the roots are biased and the exact bias is computed for some situations. A Monte Carlo simulation is performed for more general cases and the bias is again apparent. The effects of the bias in the study of principal components

and in the estimation of the inverse of Wishart matrices are discussed. Author (GRA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N76-32955 Mississippi State Univ., State College.
CLOSED LOOP OPTIMIZATION IN STATE SPACE WITH DYNAMIC COMPENSATORS Ph.D. Thesis
James Bert Nail 1976 104 p
Avail: Univ. Microfilms Order No. 76-21204

A numerical technique for the iterative design of compensation for linear, time-invariant control systems is presented. The design philosophy underlying this technique is to attempt to design dynamic feedback compensation so that the closed loop eigenvalues are affected in a desirable manner. In using this technique eigenvalues can be encouraged to migrate either toward or further into the left half plane, or they can be encouraged to migrate toward desired values. This encouraged process is accomplished by solving an unconstrained minimization problem; hence, an appropriate cost function is selected. The algorithm is based heavily on Danilevskii's method for generating a characteristic polynomial. Dissert. Abstr.

N76-32956 California Univ., Los Angeles.
THE DESIGN OF LINEAR SYSTEMS BY DISCRETE OUTPUT FEEDBACK Ph.D. Thesis
Albert Ben Chammas 1976 214 p
Avail: Univ. Microfilms Order No. 76-20192

For time invariant systems, it is shown that complete controllability and complete observability are necessary and sufficient conditions for discrete time pole assignment by output feedback. An algorithm that can be used in the syntheses of periodic output feedback gains for discrete time pole assignment is presented. For stochastic linear systems, the syntheses of output feedback controllers that minimize the state covariance at the sampling time is considered. These controllers have the advantages of being relatively easier to compute and implement in real time. Output feedback controllers that are optimal with respect to other quadratic cost criteria are also presented. The above results are developed for the case in which the control varies continuously in time between observations and the case where it is constrained to be piecewise constant. Dissert. Abstr.

N76-32957# Army Electronics Command, Fort Monmouth, N.J.
RANDOMIZATION EFFECTS IN HYPOTHESIS TESTING WITH AUTOCORRELATED NOISE
Elton P. Avara Feb. 1976 32 p refs
(DA Proj. 1T1-62111-AH-71)
(AD-A022891; ECOM-5585) Avail: NTIS CSCL 12/1

In the presence of white noise, randomization is a powerful tool in the design of an experiment where the purpose of the experiment is to accept or reject one or more hypotheses. Randomization allows the experimenter to eliminate the influence of uncontrollable biases or trends upon the results of the experiment. In the presence of colored noise, however, the use of randomization may have a catastrophic effect upon the results of the hypothesis testing. The effects of several common randomization schemes upon the variance ratio test (F-test) are investigated under the assumption the noise is autocorrelated. Detailed results are presented by using a linear first-order Markov noise model in each randomization scheme. Author (GRA)

N76-32958# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SOME EXPLICIT FORMULAS FOR THE STEADY-STATE BEHAVIOR OF THE QUEUE WITH SEMI-MARKOVIAN SERVICE TIMES Interim Report
Marcel F. Neuts Feb. 1976 28 p refs Presented at Statistics Days, Ball State Univ., Muncie, Ind., 9-10 Apr. 1976
(Grant AF-AFOSR-2350-72; AF Proj. 9769)
(AD-A023427; Mimeo-Ser-444; AFOSR-76-0170TR) Avail: NTIS CSCL 12/1

This paper discusses a number of explicity formulas for the steady-state features of the queue with Poisson arrivals in groups of random sizes and semi-Markovian service times. Computationally useful formulas for the expected duration of the various busy periods, for the mean numbers of customers served during them, as well as for the lower order moments of the queue lengths, both in discrete and in continuous time, and of the virtual waiting time are obtained. The formulas are recursive matrix expressions, which generalize the analogous but much simpler results for the classical M/G/1 model. Author (GRA)

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N76-32959 Mississippi Univ., University.
GENERALIZED QUASI ABSOLUTELY CONTINOUS FUNCTION AND A GENERALIZED QUASI STIELTJES INTEGRAL Ph.D. Thesis
Billy Ray Austin 1976 56 p
Avail: Univ. Microfilms Order No. 76-20517

Quasi absolutely continuous functions were investigated. One of the main results is that a continuous, quasi absolutely continuous function with respect to a nondecreasing function u is absolutely continuous with respect to u. The generalized Stieltjes integral is defined and its properties are developed. The results are given. An example of a function which is generalized quasi Stieltjes integrable and not Lebesgue integrable is given. Also included is an example of a function which is Lebesgue integrable and not generalized quasi Stieltjes integrable. Dissert. Abstr.

N76-32960 New York Univ., N.Y.
APPLICATIONS OF TOPOLOGICAL METHODS IN NONLINEAR PROBLEMS Ph.D. Thesis
John Tavantzis 1976 38 p
Avail: Univ. Microfilms Order No. 76-19553

The problem of existence in an annulus R sub 1 < the norm of the vector x > R sub 2 is considered. The restriction of I-K to the boundary of the annulus is deformed to (G sub r)(x) = (x sub r) + (Phi sub r)(w sub r) for r = 1,2, and the norm of the vector x = R sub r where w sub r is an element of a finite dimension space W sub r and (Phi sub r)(w sub r) lies in a subspace of W sub r. When normalizing Phi sub r to the maps Psi sub r which takes spheres into spheres, x-K(x) = 0 has a solution in the annulus if and only if the (Psi sub r's) are in different stable homotopy classes. This result is applied to obtain an existence theorem for nontrivial solutions of the equation Ax + G(x) = 0, where A is a linear Fredholm operator of index i > or = 0, G is compact, G(0) = 0, and G satisfies certain conditions for small and large x. The partial differential equation Lu = g(x,u,...,(D sup (m-1)u) is considered where L is an elliptic operator of order m and of index zero, g satisfies certain growth conditions for large values of its arguments, and behaves like a homogeneous polynomial for small values. Dissert. Abstr.

N76-32961 Princeton Univ., N.J.
FUNCTIONAL EQUATIONS WITH APPLICATIONS TO MULTITYPE GALTON-WATSON BRANCHING PROCESSES Ph.D. Thesis
Fred Michael Hoppe 1975 143 p
Avail: Univ. Microfilms Order No. 76-20366

The multitype Galton-Watson process was studied for all cases of criticality. Attention was paid in particular to problems concerning limit laws, the existence and uniqueness of invariant measures, and immigration. Techniques of multidimensional functional iteration were developed to accommodate four types of functional equations arising in branching processes, the Schroder equation, the generalized Schroder equation, the Abel equation, and the Poincare equation, and these methods were then applied to deduce new theorems and give refinements of existing results without extraneous moment hypotheses. As in the single type theory, a functional equation approach is shown to be of considerable value in the study of multitype branching processes. Regular variation enters into the multitype theory where the most natural notion appears to be regular variation in the usual sense along a fixed direction. The supercritical limit theorem

was obtained. The concept of a sequence of backwards iterates was introduced. Dissert. Abstr.

N76-32962 Princeton Univ., N.J.
TANGENTS TO THE PRESSURE AS INVARIANT EQUILIBRIUM STATES IN STATISTICAL MECHANICS OF LATTICE SYSTEMS Ph.D. Thesis
Robert Brian Israel 1975 149 p
Avail: Univ. Microfilms Order No. 76-20367

The characterization of invariant equilibrium states by tangent functionals to a convex funtion (the pressure) on a Banach space of interactions was studied. Some applications in this setting of results about convex functions on Banach spaces are considered. Both classical and quantum lattice systems (including classical continuous-spin systems) are examined. New and more direct proofs are given for some known results: tangent functionals to the pressure determine translation-invariant states satisfying the Gibbs variational principle, and these states also satisfy the DLR equations (in the classical case) or KMS condition (in the quantum case) for interactions in a suitable space. There are two main areas of new results. The first uses a version of a theorem of Bishop and Phelps to obtain existence results for phase transitions. The second area of new results is a version of the Gibbs Phase Rule using Hausdorff dimension. The Heisenberg theory is also discussed. Dissert. Abstr.

N76-32963 California Univ., Los Angeles.
SEQUENTIAL SYSTEM IDENTIFICATION BY MULTIPLE HYPOTHESIS TESTING Ph.D. Thesis
Robert Lawrence Tomanek 1976 180 p
Avail: Univ. Microfilms Order No. 76-20217

A sequential technique for performing system identification by the use of multiple hypothesis testing is investigated. The system model used is a discrete-time linear Gauss-Markov model. Using Bayesian decision theory a sequential relationship for the a posteriori probability of a hypothesis is obtained for each hypothesis. Several measures of convergence for this identification technique are then presented. Upper bounds on the expected value of the number of observations required to identify the system are derived, and the effects of various a priori parameters on this convergence measure are investigated. After developing this sequential technique for identifying the unknown parameter vector, the advantages and limitations of this approach are investigated, and several detailed examples are given to demonstrate the use of this system identification technique. These examples are drawn from one of the several areas of applications where this technique appears to offer advantages as an on-line identification method. Dissert. Abstr.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N76-32964# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTERIZED DATA BASE OF THE FUNDAMENTAL CONSTANTS OF NATURE
E. A. Henry and V. E. Hampel 3 Dec. 1975 18 p refs
(Contract W-7405-eng-48)
(UCRL-51969) Avail: NTIS HC $4.00

Fundamental constants of nature were computerized from up-to-date evaluations. The constants are annotated with regard to symbol, value, uncertainty, and scaling factor. This computerization is part of the scientific data base project of the Information Research Group at Lawrence Livermore Laboratory. The MASTER CONTROL data base management system is used. The computerized fundamental constants can be requested from the ERDA Computer Program Exchange and Information Center of the Argonne National Laboratory or from the National Technical Information Service of the U.S. Department of Commerce. ERA

N76-32965# California Univ., Livermore. Lawrence Livermore Lab.
THEORETICAL CONSIDERATION OF POSSIBLE NONLINEARITIES IN THE OPTICAL FARADAY EFFECT FOR PULSED HIGH MAGNETIC FIELDS
R. J. Vernon 9 Dec. 1975 26 p refs Sponsored by ERDA
(UCID-16972) Avail: NTIS HC $4.00

The possible nonlinearities in the optical Faraday effect in insulating materials when used for measuring pulsed magnetic fields at very high flux density is discussed. Possible sources considered are direct high field nonlinearity, magnetic breakdown, electrooptic effects from the accompanying electric field, magnetostriction and electrostriction, the Voigt effect from field inhomogeneity or misalignment, delay in response to the magnetic pulse, and shock induced luminescence. Diamagnetic glasses and fused quartz are used for the measurements.
Author (ERA)

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N76-32966 Purdue Univ., Lafayette, Ind.
NOISE IDENTIFICATION AND REDUCTION FOR A ROTARY VANE COMPRESSOR Ph.D. Thesis
William Robert Thornton 1972 161 p
Avail: Univ. Microfilms Order No. 76-20257

The noise sources and noise transmission paths of a rotary vane compressor are investigated along with the reduction of the noise radiated by the compressor. The compressor noise spectrum in the 0-3 KHz frequency range was found to be essentially a line spectrum superimposed on low level broad band noise. The analysis of the spectrum indicated that the primary source of noise was generated by the pumping action of the compressor. It was determimed that the mechanical transmission of noise between the pump-motor unit and the shell was more significant than the acoustical transmission of noise. These results were determined by measuring the acceleration of the pump-motor unit and by establishing a correlation between the acceleration spectrum and the sound spectrum of the shell. A noise reduction of the compressor was implemented by using a spring suspension system between the pump-motor unit and the shell for vibration isolation and impedance mismatching. Dissert. Abstr.

N76-32967 Purdue Univ., Lafayette, Ind.
THE POTENTIAL OF ULTRASONICS IN SHEARING MICRO-SIZE SHEET METAL Ph.D. Thesis
Atir Fadhil Abbass Fadhli 1972 182 p
Avail: Univ. Microfilms Order No. 76-21070

Ultrasonic shearing is a totally new concept utilizing the effect of high amplitude ultrasonic pressure pulse generated in a fluid; electrical energy is released from its storage through a specially designed transducer submerged in the fluid to perform a metal shearing operation. The theory has been developed for this concept, and an experimental apparatus was designed and built to evaluate the validity of the theory, followed by an experimental investigation to determine the efficiency of the operation. Finally, a relation between the energy input vs. pressure amplitude of the ultrasonic pressure pulse was established. It is of the form: $V = A + BP$. It was found that it is feasible to use high intensity ultrasonic pressure pulse for blanking micro-size sheet metal. The blanking was successful without any burr.
Dissert. Abstr.

N76-32968 California Inst. of Tech., Pasadena.
NOISE PRODUCED BY THE INTERACTION OF ACOUSTIC WAVES AND ENTROPY WAVES WITH HIGH-SPEED NOZZLE FLOWS Ph.D. Thesis
Mark Stephen Bohn 1976 221 p
Avail: Univ. Microfilms Order No. 76-20425

Some aspects of the noise generated internally by a turbojet engine are considered analytically and experimentally. The emphasis is placed on the interaction of pressure fluctuations and entropy fluctuations, produced by the combustion process in the engine, with gradients in the mean flow through the turbine blades or the exhaust nozzle. The one dimensional interaction of pressure fluctuations and entropy fluctuations with

a subsonic nozzle is solved analytically. The acoustic waves produced by each of three independent disturbances are investigated. Some of the second order effects which result from the area variations in a nozzle are investigated analytically. The interaction of an entropy wave with a small area variation is investigated and the two dimensional duct modes, which propagate away from the nozzle, are calculated. Dissert. Abstr.

N76-32969 Wisconsin Univ., Milwaukee.
ULTRASONIC ATTENUATION STUDIES OF THE SPIN-PHONON INTERACTION IN TERBIUM, DYSPROSIUM, AND HOLMIUM Ph.D. Thesis
Ralph Aluysius Treder, Jr. 1975 218 p
Avail: Univ. Microfilms Order No. 76-19350

The ultrasonic attenuation for longitudinal waves in terbium and dysprosium, and for shear waves in holmium, was measured in single crystal samples of these rare earth metals. The experiments on terbium and dysprosium were performed while a magnetic field was applied normal to the c axis of these crystals; several other field orientations were used in the holmium experiments. The observed ultrasonic attenuation as a function of the applied magnetic field in terbium and dysprosium for the paramagnetic region disclosed the following characteristics: near the spin-spiral ordering temperature the attenuation in terbium first increased and then decreased, whereas in dysprosium the attenuation first decreased and then increased, as a function of the applied field strength. At high enough temperatures, however, the attenuation in both terbium and dysprosium was observed to monotonically increase as a function of the applied field strength. Dissert. Abstr.

N76-32970 Purdue Univ., Lafayette, Ind.
ESTIMATION OF FREQUENCY RESPONSE IN ACOUSTICAL SYSTEMS WITH PARTICULAR APPLICATION TO DIESEL ENGINE NOISE Ph.D. Thesis
Andrew Frederick Seybert 1975 273 p
Avail: Univ. Microfilms Order No. 76-20396

The use of single and multiple-input linear models representing acoustical systems is discussed. A simple acoustical system, composed of electronic loudspeakers, is used to demonstrate the important aspects of spectral analysis and the estimation of frequency response functions. Theory is derived showing that bias errors are inherent in the estimation of the frequency response and coherence functions of acoustical systems. These bias errors are due to the time delay present in acoustical transmission and are a function of the magnitude of the time delay as well as the analysis bandwidth. Experimental measurements of the bias error agree favorably with that predicted by theory. It is shown that the bias errors can be eliminated by aligning the input and output time records before analysis. Also presented is theory demonstrating conditions under which cross-spectra between inputs can be neglected. Dissert. Abstr.

N76-32971*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
DATA ANALYSIS AND NOISE PREDICTION FOR THE QF-1B EXPERIMENTAL FAN STAGE
D. B. Bliss, K. L. Chandiramani, and A. G. Piersol Aug. 1976 118 p refs
(Contract NAS3-19426)
(NASA-CR-135066; BBN-3338) Avail: NTIS HC $5.50 CSCL 20A

The results of a fan noise data analysis and prediction effort using experimental data obtained from tests on the QF-1B research fan are described. Surface pressure measurements were made with flush mounted sensors installed on selected rotor blades and stator vanes and noise measurements were made by microphones located at the far field. Power spectral density analysis, time history studies, and calculation of coherence functions were made. The emphasis of these studies was on the characteristics of tones in the spectra. The amplitude behavior of spectral tones was found to have a large, often predominant, random component, suggesting that turbulent processes play an important role in the generation of tonal as well as broadband noise. Inputs from the data analysis were used in a prediction method which assumes that acoustic dipoles, produced by unsteady blade and van forces, are the important source of fan noise. Author

N76-32972*# Boeing Commercial Airplane Co., Seattle, Wash.
STATIC AND WIND TUNNEL NEAR-FIELD/FAR-FIELD JET NOISE MEASUREMENTS FROM MODEL SCALE SINGLE-FLOW BASELINE AND SUPPRESSOR NOZZLES. VOLUME 1: NOISE SOURCE LOCATIONS AND EXTRAPOLATION OF STATIC FREE-FIELD JET NOISE DATA
C. L. Jaeck Sep. 1976 184 p refs
(Contract NAS2-8213)
(NASA-CR-137913; D6-44121-1-Vol-1) Avail: NTIS HC $7.50 CSCL 20A

A test was conducted in the Boeing Large Anechoic Chamber to determine static jet noise source locations of six baseline and suppressor nozzle models, and establish a technique for extrapolating near field data into the far field. The test covered nozzle pressure ratios from 1.44 to 2.25 and jet velocities from 412 to 594 m/s at a total temperature of 844 K. Author

N76-32973*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
MEASURED NOISE REDUCTIONS RESULTING FROM MODIFIED APPROACH PROCEDURES FOR BUSINESS JET AIRCRAFT
Frank W. Burcham, Jr., Terrill W. Putnam, Paul L. Lasagna, and O. Owen Parish Nov. 1975 31 p refs
(NASA-TM-X-56037) Avail: NTIS HC $4.00 CSCL 20A

Five business jet airplanes were flown to determine the noise reductions that result from the use of modified approach procedures. The airplanes tested were a Gulfstream 2, JetStar, Hawker Siddeley 125-400, Sabreliner-60 and LearJet-24. Noise measurements were made 3, 5, and 7 nautical miles from the touchdown point. In addition to a standard 3 deg glide slope approach, a 4 deg glide slope approach, a 3 deg glide slope approach in a low-drag configuration, and a two-segment approach were flown. It was found that the 4 deg approach was about 4 EPNdB quieter than the standard 3 deg approach. Noise reductions for the low-drag 3 deg approach varied widely among the airplanes tested, with an average of 8.5 EPNdB on a fleet-weighted basis. The two-segment approach resulted in noise reductions of 7 to 8 EPNdB at 3 and 5 nautical miles from touchdown, but only 3 EPNdB at 7 nautical miles from touchdown when the airplanes were still in level flight prior to glide slope intercept. Pilot ratings showed progressively increasing workload for the 4 deg, low-drag 3 deg, and two-segment approaches. Author

N76-32974*# United Technologies Research Center, East Hartford, Conn.
ACOUSTIC RADIATION AND SURFACE PRESSURE CHARACTERISTICS OF AN AIRFOIL DUE TO INCIDENT TURBULENCE Final Report
Robert W. Paterson Washington NASA Sep. 1976 106 p refs
(Contract NAS1-13823)
(NASA-CR-2733) Avail: NTIS HC $5.50 CSCL 20A

A theoretical and experimental investigation of the noise and unsteady surface pressure characteristics of an isolated airfoil in a uniform mean velocity, homogeneous, nearly-isotropic turbulence field was conducted. Wind tunnel experiments were performed with a 23 cm chord, two dimensional NACA 0012 airfoil over a free stream Mach number range of 0.1 to 0.5. Far-field noise spectra and directivity were measured in an anechoic chamber that surrounded the tunnel open jet test section. Spanwise and chordwise distribution of unsteady airfoil surface pressure spectra and surface pressure cross-spectra were obtained. Incident turbulence intensities, length scales, spectra, and spanwise cross-spectra, required in the calculation of far-field noise and surface pressure characteristics were also measured. Author

N76-32975# Manlabs, Inc., Cambridge, Mass.
NOISE ABATEMENT AND INTERNAL VIBRATION ABSORPTION IN POTENTIAL STRUCTURAL MATERIALS Semi-annual Report, 1 Mar. - 11 Sep. 1975
L. Kaufman, S. A. Kulin, and P. P. Neshe Jan. 1976 56 p refs
(Contract DAAG46-74-C-0048; ARPA Order 2555)
(AD-A022784; AMMRC-CTR-76-3; SAR-3) Avail: NTIS CSCL 20/1

Efforts have been directed toward achieving higher yield strengths in high damping cobalt-iron base alloys by adding nickel, aluminum and manganese. Substantial increases have been achieved through aluminum and manganese additions at low levels. The range of loss factors and yield strengths which are attainable exceed currently available commercial materials. Measurement of the temperature dependence of the loss factor of the cobalt-iron alloy for comparison with Nitinol and Incramute show that the cobalt-iron alloy retains a high loss factor up to 120 C while the latter materials exhibit a drop in loss factor well below 100 C. The effects of alloying additions of iron and manganese as well as reduction in grain size are being investigated as a means for reducing the brittleness of copper-aluminum-nickel alloys which exhibit thermoelastic martensitic transformations. These transformations provide high damping characteristics and high loss factors. Author (GRA)

N76-32976# Texas Univ., Austin. Applied Research Labs.
THE SUPPRESSION OF SOUND WITH SOUND Interim Report
Mark E. Schaffer Dec. 1975 89 p refs
(Contracts F44620-76-C-0040; N00014-75-C-0867; AF Proj. 9781)
(AD-A023128; ARL-TR-75-64; AFOSR-76-0438TR) Avail: NTIS CSCL 20/1

An experiment was performed in which a finite-amplitude wave of frequency f1 interacted with a small-signal wave of frequency f2. The interaction, which resulted in an apparent excess attenuation of the signal at f2, occurred during planar, collinear propagation of the two signals in a 96 ft long, 2 in. i.d. progressive wave tube. The properties of the signals at the source were as follows: f1 = 769-1000 Hz, SPL1 = 130-150 dB, f2 = 2800-10,500 Hz, SPL2 < 110 dB. Propagation distances were 12.8 and 24.8 ft. A one-way modulation theory, the well known frequency modulation (FM) theory, and Fenlon's intermodulation theory (J. Acoust. Soc. Am. 51, 284-289 (1972)), both slightly modified to account for tube wall attenuation, were used to analyze the interaction. In one experiment, attempts to suppress the weak signal via the interaction resulted in amplitude reductions of as much as 40 dB. The results of another experiment, involving a spectral analysis, indicate that spectral amplitude predictions made using the modified Fenlon theory agree more closely with measured amplitudes than do predictions made using the modified FM theory. Author (GRA)

N76-32977# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
PROPELLER ACOUSTIC RESEARCH (ISOLATED AIRFOIL NOISE) Final Report, 1 Oct. 1971 - 30 Jun. 1975
Craig A. Lyon, Paul A. Shahady, and William C. Elrod Dec. 1975 61 p refs
(AD-A023071; AFAPL-TR-75-78) Avail: NTIS CSCL 20/1

This report describes the development of a quiet, free jet wind tunnel for aero-acoustic research on isolated airfoils. Analytical expressions are developed for boundary layer noise, noise due to upstream turbulence, and shed vortex noise. Preliminary experimental tests were conducted to determine airfoil noise levels due to upstream turbulence and shed vortices. The results are in good agreement with the analytical predictions. Pure tone components are present in the acoustic spectra, verifying the findings of recent investigators. The theories of Tam and Fink are briefly reviewed. Tone frequencies determined during the preliminary tests agree well with the prediction model of Fink. The report presents a brief technical plan outlining additional research required. The objectives of the recommended program are to clearly define both the broadband and pure tone mechanisms of isolated airfoil noise, to define the effects of rotation on these mechanisms through static model propeller testing and finally to assess the effects of forward flight through quiet wind tunnel testing. Author (GRA)

N76-32978# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
OPTIMAL PARAMETER ESTIMATION FROM NEAR FIELD MEASUREMENTS Technical Report, 1975 - 1976
Donald A. Murphy, P. Craig Bogley, and Neil J. Bershad 15 Apr. 1975 43 p refs
(Contract N00014-69-C-0034)
(AD-A023590; FR-76-11-297) Avail: NTIS CSCL 20/1

The techniques of optimal estimation theory are applied to determining the parameters of an acoustic field using a line array of sensors in the near field. The joint maximum likelihood estimation of point source range, bearing and power spectral density is derived assuming white noise and knowledge of its spatial covariance. Determination of the localization parameter estimates is shown to be independent of the estimation of power. Four methods are evaluated for estimating the noise spatial covariance matrix of a line array in the presence of a known signal. For the case of known signal and noise means two ad hoc schemes are developed. The mean and variance of a far-field power estimate as a function of near field pressure measurements are calculated using a Green's transfer function. The analysis used to derive the optimum processing structure for the two point source resolution problem is extended and generalized for multiple point sources. GRA

N76-32979# School of Aerospace Medicine, Brooks AFB, Tex.
NOISE LEVELS MEASURED WITHIN AIRCRAFT DURING TAKEOFF, CLIMB AND CRUISE (LOW, NORMAL, AND HIGH) Progress Report, Mar. - Oct. 1975
Donald C. Gasaway Feb. 1976 23 p refs
(AF Proj. 7755)
(AD-A023407; SAM-TR-76-9) Avail: NTIS CSCL 20/1

Noise measurements obtained within cockpits of 12 groups of fixed and rotary wing aircraft during takeoff, climb, and cruise are reported. Mean, variance, and standard deviations are given for each group. Data include flat F or C weighted levels, A weighted levels, and F/C minus A levels. Author (GRA)

N76-32366* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT NOISE PREDICTION
Jimmy Cawthorn and Ronnie Gillian *In* Shock and Vibration Information Center Shock and Vibration Computer Programs 1975 p 497-505 refs (For availability see N76-32339 23-31) CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N76-32980 Cornell Univ., Ithaca, N.Y.
STABILIZATION OF THE PRECESSIONAL MODE FOR STRONG SELF-FIELD RELATIVISTIC ELECTRON RINGS Ph.D. Thesis
David Monroe Woodall 1976 217 p
Avail: Univ. Microfilms Order No. 76-21150

Electrons of 500 KeV from a high current relativistic electron beam device were trapped with a ring geometry between magnetic mirrors. The temporal behavior of such rings exhibited a constant decay rate, shown to be classical, and a final dump at low field strength. This instability is explored and the results are compared to a similar dump observed for the Livermore Astron experiments. Electron ring stability was analyzed by varying the magnetic field configuration. External field coils were used to add toroidal, quadrupole, and transverse gradient fields to the mirror trap field. The principal interest was in studying the effect of such fields on the final dump, but other effects, such as ring trapping without the usual wall stabilization, were also pursued. Dissert. Abstr.

N76-32981 Carnegie-Mellon Univ., Pittsburgh, Pa.
THE PHOTON-PHOTON SCATTERING CONTRIBUTIONS TO THE SIXTH ORDER ANOMALOUS MAGNETIC MOMENTS OF THE ELECTRON AND THE MUON Ph.D. Thesis
Chin Tse Chang 1976 167 p
Avail: Univ. Microfilms Order No. 76-19324

The contributions of the light-by-light scattering graphs to the sixth order anomalous magnetic moments of the electron and the muon are evaluated. This is the dominant quantum electrodynamics contribution for the muon in the sixth order. Results agree roughly with those values obtained by Aldins et

al., Peterman, and Samuel. The numerical integration techniques which were used are discussed in detail. Dissert. Abstr.

N76-32982 California Inst. of Tech., Pasadena.
ELECTRONIC SPECTROSCOPY OF PION-BONDED, POLY-ATOMIC MOLECULES BY ELECTRON IMPACT Ph.D. Thesis
Wayne Michael Flicker 1976 709 p
Avail: Univ. Microfilms Order No. 76-19574

Low energy, variable angle electron impact spectroscopy was used to investigate the electronic excitation spectra of twenty-six molecules. Previously unreported singlet to triplet transitions were assigned on the basis of the shape of observed relative differential scattering cross sections, and on the impact energy dependence of the transition intensity. In addition, many singlet-singlet excitations were observed to high-lying super-excited states, most of which had not been detected previously. The molecules studied intensively included chloroethylene and the six methyl-substituted ethylenes; furan, thiophene, and pyrrole; propyne and 1-butyne; nitromethane; and carbon disulfide, carbonyl sulfide, and sulfur dioxide. The remaining molecules included ammonia, dimethyl ether, hydrogen sulfide, methylamine, nitric oxide, acetonitrile, pyridine, 3,3,3-trifluoropropyne, carbon dioxide, and ethylene.
Dissert. Abstr.

N76-32983 New York Univ., N.Y.
MULTIPLE INNER SHELL VACANCY AND REARRANGEMENT EFFECTS ON K AND L-SHELL X-RAYS PRODUCED IN HEAVY ION-ATOM COLLISIONS Ph.D. Thesis
John Allen Tanis 1976 230 p
Avail: Univ. Microfilms Order No. 76-19552

The effects of multiple ionization and electronic rearrangement on the X-ray spectra resulting from collisions of heavy ions with atoms were studied. The projectile energy dependence of the L X-rays of Ba, Sm, Eu, Yb, and Au produced by incident Br79 projectiles of energy .125-1.8 MeV/amu and of the L X-rays of Sm, Ho, and Yb produced by incident I127 projectiles of energy .23 - 1.0 MeV/amu were first examined. The X-ray cross sections, relative intensity ratios, and energy shifts were determined and the results were compared to predictions of Coulomb excitation as well as Pauli excitation. A high resolution measurement of the K sub Alpha spectrum of Fe produced by I127 projectiles at 100 and 166.6 MeV was then performed. This spectrum can be resolved into six individual peaks corresponding to X-ray emission in the presence of 0 - 5 L vacancies. The positions, widths, and intensities of the peaks were determined and the results are discussed in terms of Coulomb ionization.
Dissert. Abstr.

N76-32984 City Univ. of New York.
CORRELATION OF THE VAPOR PRESSURE ISOTOPE EFFECT WITH MOLECULAR FORCE FIELDS IN THE LIQUID STATE Ph.D. Thesis
James Stuart Pollin 1976 243 p
Avail: Univ. Microfilms Order No. 76-21182

A model for condensed phase interactions is described with which the vapor pressure isotope effect (vpie) may be related to molecular forces and structure. The model considers the condensed phase as being represented by a cluster of regularly arranged molecules consisting of a central molecule and a variable number of molecules in the first coordination shell. Normal coordinate analysis are used to determine the modes of vibration of the condensed phase cluster from which, in turn, the isotopic reduced partition function can be calculated. Using the medium cluster model, the observed vpie for a series of methane isotopes was successfully reproduced with better agreement with experiment than possible using the simple cell model. It was concluded, however, that the vpie is not sufficiently sensitive to molecular orientation to permit an experimental determination of intermolecular configuration in the condensed phase.
Dissert. Abstr.

N76-32985 New York Univ., N.Y.
EFFECTS OF PHASE TRANSITIONS ON THE POSITRON ANNIHILATION CHARACTERISTICS IN IONIC AND VAN DER WAALS SUBSTANCES Ph.D. Thesis
Gottfried Bernhard Duerr 1976 201 p
Avail: Univ. Microfilms Order No. 76-19497

Positron lifetime spectra were measured in the ionic solids of the ammonium halides and the van der Waals solids and liquids of perhalogenated methanes and silanes. Their dependence on solid-solid and solid-liquid phase transitions was studied. Positronium (Ps) is formed in several of the halogenated methanes and silanes as predicted by the free volume model. The analysis of the dependence of the Ps yield on the sample density shows that Ps formed whenever the substance has free volumes in excess of approximately 0.35 v sub O where v sub O is the volume inaccessible to the positron due to the repulsion by the atom cores. The pick-off lifetime of ortho positronium (oPs) decreases with temperature in some of the substances when molten. This is shown to indicate that thermal density fluctuations in these liquids rather than the thermal expansion, determine the rate of electron pick-off by oPs from the molecules.
Dissert. Abstr.

N76-32986# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
SPECTROSCOPIC CONSTANTS FOR SELECTED HOMONUCLEAR DIATOMIC MOLECULES. VOLUME 2: K THROUGH Z Interim Report
Steven N. Suchard and James E. Melzer 16 Feb. 1976 274 p refs
(Contract F04701-75-C-0076; DARPA Order 2843)
(AD-A022148; TR-0076(6751)-1-Vol-2; SAMSO-TR-76-31-Vol-2) Avail: NTIS CSCL 20/10

Spectroscopic information relevant to homonuclear diatomic molecules has been collected and is presented. This information includes not only the molecular band systems, but also Franck-Condon factors, oscillator strengths, potential energy curves, and reactive branching ratios, where available. The information is arranged alphabetically by molecule in two volumes. This the second volume, covers K through Z. Author (GRA)

N76-32987# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
SPECTROSCOPIC CONSTANTS FOR SELECTED HOMONUCLEAR DIATOMIC MOLECULES. VOLUME 1: A THROUGH I Interim Report
Steven N. Suchard and James E. Melzer 16 Feb. 1976 317 p refs
(Contract F04701-75-C-0076; DARPA Order 2843)
(AD-A022147; TR-0076(6751)-1-Vol-1; SAMSO-TR-76-31-Vol-1) Avail: NTIS CSCL 20/10

Spectroscopic information relevant to homonuclear diatomic molecules has been collected and is presented. This information includes not only the molecular band systems, but also Franck-Condon factors, oscillator strengths, potential energy curves, and reactive branching ratios, where available. The information is arranged alphabetically by molecule in two volumes. This, the first volume, covers A through I. Author (GRA)

N76-32988# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
COHERENT ELECTRON IMPACT EXCITATION OF DIFFERENT L STATES IN THE n=3 SHELL OF ATOMIC HYDROGEN Final Report
Stephen J. Smith 1976 12 p refs Presented at the Intern. Symp. on Electron and Photon Interactions with Atoms, Stirling, Scotland, 16-19 Jul. 1974
(Grant NSF GP-39308)
(PB-252771/1) Avail: NTIS HC $3.50 CSCL 07D

An interpretation of a measurement by Mahan, Gallagher, and Smith of the Balmer-alpha intensity excited by electron impact on a diffuse atomic hydrogen beam in an external electric field, is presented. An asymmetry in the Balmer-alpha intensity perpendicular to the electron beam, as a function of the direction of an electric field parallel (or antiparallel) to the electron beam axis, is discussed in terms of displacement of the electron charge cloud during the collision, an interpretation which is also applicable to some recent results of beam foil spectroscopy. GRA

N76-32989# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
RECENT ADVANCES IN POLARIZED-ELECTRON EXPERIMENTS Final Report
Joachim Kessler 1975 16 p refs Presented at the 9th Intern. Conf. on the Physics of Electronic and Atomic Collisions, Seattle, Wash., 24-30 Jul. 1975

(PB-252774/5) Avail: NTIS HC $3.50 CSCL 07D

Recent experimental progress on collisional and radiative processes involving electron spin polarization is reviewed. The various processes of this type are summarized. Work carried out in several laboratories on polarization effects in scattering by free atoms, in scattering by surfaces, in single- and multi-photon ionization of atoms, as well as in photoelectron emission from certain solid surfaces are reviewed. GRA

N76-32990# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
A NEW MEASUREMENT OF THE RELATIVISTIC DOPPLER SHIFT Final Report
J. J. Snyder 1975 12 p refs Presented at the 2nd Intern. Conf. on Laser Spectroscopy, Megeve, France, Jun. 1975
(Grant NSF GP-39308)
(PB-252777/8) Avail: NTIS HC $3.50 CSCL 07D

Saturated absorption laser spectroscopy allows, in principle, the study of atomic absorption lines free from first-order Doppler effects. However, the second order Doppler effect is not suppressed, as it is a manifestation of the time dilation of special relativity. The authors describe an experiment using a stabilized visible cw dye laser to study the absorption of metastable neon atoms moving at high speed transversely to the laser beam. The dye laser has been stabilized to about 50 kHz absolute, considering linewidth as well as frequency jitter and drift. The observed time dilation effect is in agreement with the predictions of special relativity at the 1/2% noise level of the first preliminary experiment. GRA

N76-32991# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
ENERGY EXCHANGES BETWEEN TWO ESCAPING ELECTRONS Final Report
F. H. Read 1976 20 p refs Presented at the 9th Intern. Conf. on the Physics of Electronic and Atomic Collisions, Seattle, 24-30 Jul. 1975
(PB-252729/9) Avail: NTIS HC $3.50 CSCL 07D

The final-state Coulomb interaction between three or more outgoing charged particles from a reaction can cause exchanges of energy and angular momentum between them. Such exchanges may be present for example when the reaction product consists of two electrons receding from a positive ion. The experimental evidence for the existence of such effects in threshold ionization and threshold autoionization are reviewed, and their possible theoretical descriptions are discussed. GRA

N76-32992# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
EXCITATION AND IONIZATION IN THE COULOMB-PROJECTED BORN APPROXIMATION Final Report
Sydney Geltman 1976 11 p refs Repr. from Proceedings of Intern. Symp. on Electron and Photon Interactions with Atoms (Stirling, Scotland) 16-19 Jul. 1974 p 387-396
(PB-252770/3) Avail: NTIS HC $3.50 CSCL 07D

The physical basis of the Coulomb-projected Born method is described and the similarities and differences of its predictions with those of the usual Born approximation discussed and compared with available experimental data. GRA

N76-32993# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
SPECTRAL RESOLUTION OF NEAR-RESONANT RAYLEIGH SCATTERING AND COLLISION-INDUCED RESONANCE FLUORESCENCE Final Report
J. L. Carlsten and A. Szoke 1 Dec. 1975 6 p refs Repr. from physical review letters, v. 36, no. 12, 22 Mar. 1976 p 667-671
(Grant NSF GP-39308)
(PB-252769/5) Avail: NTIS HC $3.50 CSCL 07D

Light scattered from strontium vapor near its 460.73-nm (singlet P(1)-singlet S(0) resonance transition was resolved into its three spectral components: Rayleigh scattering, collision-induced fluorescence, and three-photon scattering. The saturation behavior of the central (Rayleigh) component and the intensity and ac Stark shift of the three-photon component were studied as a function of detuning and laser intensity. Good agreement is obtained with theoretical predictions. GRA

N76-32994# National Bureau of Standards, Washington, D.C. Optical Physics Div.
RESONANCE TRAPPING AT LOW PRESSURES Final Report
Helen K. Holt 11 Mar. 1975 7 p refs Repr. from Physical Review A, v. 13, no. 4, Apr. 1976 p 1442-1447
(PB-252731/5) Avail: NTIS HC $3.50 CSCL 07D

When a small volume of atoms within a larger one is excited by a short pulse of electrons or light, the apparent lifetime of the decaying atoms is increased by the resonance trapping in the surrounding gas. The apparent lifetime is calculated for two different geometries and line shapes, and the result of having more than one lower level is presented. GRA

N76-32995# Pittsburgh Univ., Pa. Dept. of Physics.
THEORY OF LOW-ENERGY ELECTRON-ATOM COLLISIONS AND RELATED PROCESSES Final Report
J. N. Bardsley 1975 8 p refs Repr. from Proceedings of the Intern. Conf. on the Physics of Electron. and Atomic Collisions, Seattle, 24-30 Jul. 1975 p 151-157 Sponsored by NBS, Washington, D. C.
(PB-252730/7) Avail: NTIS HC $3.50 CSCL 07D

Current proposals and investigations in the theoretical treatment of low-energy electron-atom collisions are reviewed. Successes and problem areas are cited. A characterization of the status of the field, and suggested areas for further progress are presented. GRA

N76-32996# University of Southern Calif., Los Angeles. Dept. of Physics.
ANALYSIS AND CROSS SECTIONS OF VACUUM UV ABSORPTION OF O2 IN THE GROUND (X TRIPLET SIGMA (g)(-)) AND METASTABLE (a SINGLET DELTA g) STATES Final Report, 15 Sep. 1972 - 31 Jan. 1976
Gerhard L. Weissler and Masaru Ogawa 1 Feb. 1976 14 p refs
(Grants DA-ARO(D)-31-124-73-G41; DAHC04-74-G-0015; DAHC04-75-G-0029)
(AD-A023008; USC-VACUV-175; ARO-10614.6-P) Avail: NTIS CSCL 07/4

Molecular oxygen, O2 is involved in a wide variety of significant reactions in the earth's upper atmosphere. However, a pre-1972 review of the literature revealed the surprising fact that much of the molecular structure of O2 in terms of term analysis, Morse-curves, etc., and the detailed quantitative photon interaction processes with O2 in the region from 6 to 15 eV were still largely unknown. The following research then represents an effort to bridge known gaps, and the resulting publications can be grouped under two general headings: (1) An analysis of the Vacuum UV Absorption Spectrum of neutral O2 and (2) the Measurement of Absorption Cross Sections of O2 either in the Ground or in a Metastable State. GRA

N76-32997# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
AN UNUSUAL REVERSIBLE VALENCE BOND ISOMERIZATION HEMI-DEWAR NAPHTHALENE TO NAPHTHALENE Technical Report, 30 Jun. 1975 - 28 Feb. 1976
Ira B. Goldberg and Harry R. Crowe Apr. 1976 23 p refs
(Contract N00014-73-C-0325; NR Proj. 051-553)
(AD-A022896; SC549.15TR; TR-4) Avail: NTIS CSCL 07/3

Evidence obtained by electron spin resonance indicates that 1,3,6,8-tetra-tert-butylnaphthalene and 1,3,8-tri-tert-butylnaphthalene isomerize through the dianion intermediate to form the corresponding hemi-Dewar naphthalenes. This reaction is facilitated through the non-planarity of the parent naphthalene compounds. Esr spectra of the anion radical of the hemi-Dewar naphthalene anions are reported. Author (GRA)

N76-32998# Illinois Univ., Urbana. Dept. of Chemistry.
ON THE TEMPERATURE DEPENDENCE OF LANTHANIDE-INDUCED NMR SHIFTS
E. W. Stout, Jr. and H. S. Gutowsky Feb. 1976 27 p refs
(Contract N00014-75-C-0163; NR Proj. 056-547)
(AD-A023232; TR-10) Avail: NTIS CSCL 07/4

The current theories of the origin of lanthanide-induced NMR shifts are examined and compared with one another and with experimental results in an attempt to understand the temperature dependence of the shifts. It is concluded that shifts arising from a pseudocontact mechanism should in general show a 1/T squared behavior as predicted by Bleaney. In most situations with a

fixed molecular geometry, theory does not predict a substantial 1/T component of the shift; but in some instances a fortuitous combination of crystal field parameters can lead to additional 1/T to the nth power components (n greater than or equal to 3) which cause the overall shift to appear to be a linear function of 1/T with a large intercept at 1/T = 0. Extension of Bleaney's method to the (positive) 1/T cubed term shows it to be negligible compared to that in 1/T squared for systems with J = 3/2 and relatively small (approximately 10%) for larger J. In the absence of detailed experimental studies of crystal field parameters in solution, it is likely that for the majority of lanthanide adduct systems the most realistic description of the proton shifts is in terms of the well-established 1/T squared dependence.
GRA

N76-32999# Intelcom Rad Tech, San Diego, Calif.
TIME-DEPENDENT MEASUREMENTS OF NEUTRON-INDUCED SILICON DOSE RATES IN A MISSILE GUIDANCE SYSTEM Final Report, 1 Jun. 1973 - 16 Jun. 1975
D. K. Steinman, L. Harris, Jr., S. J. Friesenhahn, J. C. Young, and N. A. Lurie 2 Jun. 1975 244 p refs
(Contract DNA001-73-C-0259; DNA Proj. NWED-QAXPE075)
(AD-A023477; INTEL-RT-8093-017; DNA-3750F) Avail: NTIS CSCL 18/4

Time-dependent measurements of silicon-ionization dose rates inside a missile guidance system due to incident neutrons from a pulsed, white-spectrum Linac source were performed. The measurements were made inside the autopilot and inside the missile guidance set for 30 deg - and 90 - deg missile orientations. Supplementary measurements were made in a simple-geometry cylinder of steel and styrofoam. The bulk-silicon-ionization dosimeter, which consisted of a silicon surface-barrier detector surrounded by silicon, was developed for these measurements. The dosimeter was calibrated for incident neutrons and gamma rays. The energy-dependent neutron calibration was converted to silicon ionization Kerma for incident-neutron energies from 3 to 20 MeV. Time-dependent measurements of count rates and energy spectra of scattered neutrons and secondary gamma rays were also performed using a NE-213 detector. The energy spectrum of incident source neutrons was measured using the NE-213 detector, a 6Li glass detector, and a BF3 detector for incident neutron energies from 0.4 eV to 20 MeV. Author (GRA)

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N76-33000 Carnegie-Mellon Univ., Pittsburgh, Pa.
A THREE-DIMENSIONAL TRANSPORT METHOD FOR LMFBR SHIELDING DESIGN ANALYSIS Ph.D. Thesis
James Allen Bucholz 1976 333 p
Avail: Univ. Microfilms Order No. 76-19323

A fast three-dimensional design-oriented transport method is developed for the solution of both neutron and gamma shielding problems. It combimes a nodal approach with analytic integral transport to achieve relative speed and accuracy. It is inherently three-dimensional and can accommodate high-order anisotropic scattering. Although evaluated primarily for LMFBR shielding configurations, the method has potential for useful application in other particle transport problems. Dissert. Abstr.

N76-33001*# College of William and Mary, Williamsburg, Va. Dept. of Physics.
TWO-ELECTRON BOND-ORBITAL MODEL, 2
Chuping Huang, John A. Moriarty, and A. Sher [1976] 79 p refs
(Grants NsG-1089; NSF DMR-75-02365)
(NASA-CR-148830) Avail: NTIS HC $5.00 CSCL 20H

The two-electron bond-orbital model of tetrahedrally-coordinated solids is generalized and its application extended. All intrabond matrix elements entering the formalism are explicitly retained, including the direct overlap S between the anion and cation sp3 hybrid wavefunctions. Complete analytic results are obtained for the six two-electron eigenvalues and eigenstates of the anion-cation bond in terms of S, one-electron parameters V2 and V3, and two-electron correlation parameters V4, V5 and V6. Refined formulas for the dielectric constant and the nuclear exchange and pseudodipolar coefficients, as well as new expressions for the valence electron density, polarity of the bond and the cohesive energy, are then derived. The theory gives a good account of the experimentally observed trends in all properties considered and approximate quantitative agreement is achieved for the pseudodipolar coefficient. Author

N76-33002# South Carolina Univ., Columbia. Dept. of Physics.
PI MESON SCATTERING Final Report
Barry M. Preedom 31 Mar. 1976 69 p refs Sponsored in part by NSF
(Contract N00014-72-A-0455-0002; NR Proj. 020-014)
(AD-A023521) Avail: NTIS CSCL 02/8

The research program described here has as its goal the investigation of pion-nucleus reactions at low energies in order to study the pion-nucleus reaction mechanism and to study nuclear properties which are particularly enhanced by the pion projectile. Low incident energies have been chosen in order to decrease the influence of the very strong P33 resonance thereby increasing the effective mean-free path of the pion in nuclear matter and allowing the data to be analyzed with perturbation techniques. The present program involves four major categories of pion reactions: (1) pion absorption on the deuteron (pion(-) - d yields p (p) at energies below 100 MeV; (2) pion-elastic scattering at energies below 60 MeV; (3) pion-inelastic scattering at energies below 60 MeV; and (4) pion-double charge exchange. GRA

N76-33003# Oregon State Univ., Corvallis.
PION-NUCLEAR INTERACTIONS AT INTERMEDIATE ENERGIES Final Research Contract Report, 1 Sep. 1974 - 28 Feb. 1975
28 Feb. 1975 18 p refs
(Contract N00014-67-A-0369-0010; NR Proj. 020-015)
(AD-A023523) Avail: NTIS CSCL 20/8

With the availability of intense beams of greatly improved energy resolution from LAMPF, interest in intermediate energy nuclear physics is at a high level. A major interest of the Oregon State University group is the study of elastic and inelastic scattering of pions from nuclei. Since pions exhibit several features not shared by low-energy nuclear projectiles they are especially interesting objects with which to probe nuclear structure in scattering experiments. This report contains a summary of instrumentation projects, and results from the experimental programs. GRA

74 OPTICS

Includes light phenomena.

N76-33004 Arizona Univ., Tucson.
CALIBRATION OF AN OPTICAL POWER SPECTRA MEASUREMENT DEVICE Ph.D. Thesis
Patrick Seale Cheatham 1976 156 p
Avail: Univ. Microfilms Order No. 76-19724

A useful measure of image quality is one that can be rapidly evaluated for any given image of interest, that correlates closely with the psychophysical assessment of quality and information, and that relates directly to merit functions of imaging systems, calculable from system design parameters. One such measure of image quality is the optical power spectrum (OPS), which describes the power in the image as a function of spatial frequency. A related measure, the signal-to-noise power spectrum (SNPS), is investigated theoretically and experimentally here and found to correlate better with information content, as it accounts for contributions to the OPS caused by film grain noise. The SNPS approach was shown to offer a good means of judging information content. Dissert. Abstr.

N76-33005 Catholic Univ. of America, Washington, D.C.
DIFFRACTION OF A PLANE WAVE BY A RIGID HYPERBOLIC CYLINDER Ph.D. Thesis
Yueh-Li-C. Li 1976 105 p
Avail: Univ. Microfilms Order No. 76-19966

The effect of the curvature of a rigid hyperbolic cylinder on the radiation field of an incident plane wave is examined. Because of the geometry of the scattering a wave function involving products of Mathieu functions is used. Effort is directed to obtain solutions of Mathieu's equation and of the Modified Mathieu equation. An exact solution of the diffraction problem in the form of an eigenfunction expansion is obtained. The Neumann boundary condition, the Sommerfield radiation condition, and continuity of the wave function and its gradient across the interfocal line are imposed on the solution. In the far field the solution consists of the solution for wedge diffraction plus correction terms due to finite curvature and displacement of the edge. Numerical solutions are presented to demonstrate the changes of the hyperbolic cylinder boundary and incident angle both for far field backscattering and bistatic diffracted waves.
Dissert. Abstr.

N76-33006 Arizona Univ., Tucson.
DIMENSIONAL STABILITY OF LOW EXPANSIVITY MATERIALS-TIME DEPENDENT CHANGES IN OPTICAL CONTACT INTERFACES AND PHASE SHIFTS ON REFLECTION FROM MULTILAYER DIELECTRICS Ph.D. Thesis
John William Berthold, III 1976 74 p
Avail: Univ. Microfilms Order No. 76-21437

Measurements to a precision of 2 to 3 parts in 1 billion were made of length change versus time for seven materials, whose lengths were monitored for 170 days. These materials were: Heraeus-Schott Zerodur and Homosil, Owens-Illinois Cer-Vit, Corning Code 7971 ULE and Code 7940 Fused Silica, Universal Cyclops Invar LR-35, and Simonds Saw and Steel Super Invar. In addition, it is deduced from the measurements time dependent changes in optical contact interface separation.
Dissert. Abstr.

N76-33007 Arizona State Univ., Tempe.
THE ELECTRON MICROSCOPY OF THICK SPECIMENS Ph.D. Thesis
Jeffrey Ronald Sellar 1976 164 p
Avail: Univ. Microfilms Order No. 76-19829

Methods of studying electron microscope specimens that resemble the native state more closely than has ever been possible before are described. The new methods are the use of thick specimens and of environmental cells, i.e., cells that support biological specimens in a hydrated or even living state. A wave-optical theory is developed which allows a comparison of the scanning and conventional microscopes to be made, by comparing the plural scattering and the chromatic aberration in each case. To investigate an experimental procedure for collecting scattered electrons efficiently in the scanning microscope, a theory is developed for the incoherent scattering of electrons in amorphous specimens, the effect of partial coherence and inelastic scattering on the imaging is estimated. It is concluded that certain configurations of the thick specimens or environmental cells will still permit high resolution electron microscopy.
Dissert. Abstr.

N76-33008 Drexel Univ., Philadelphia, Pa.
STUDY OF TRANSPORT PROCESSES IN PHOTOCONDUCTORS BY FLUCTUATION THEORY Ph.D. Thesis
Matthew James Fisher 1976 219 p
Avail: Univ. Microfilms Order No. 76-19861

Transport processes in photoconductors are investigated using fluctuation theory. The theory relates the transport mechanisms to photocurrent noise spectra. These spectra, in turn, are compared with similar spectra derived from experimental measurements. A two dimensional analysis is carried out for photoconductors in the presence of spatially uniform absorption of light energy. The study simultaneously accounts for a drift component and a perpendicular diffusion component. Resultant spectra compare favorably with measured noise spectra and, in particular, they are used to explain the lack of drift spectra in experimental data. A one dimensional analysis is performed for photoconductors under nonuniform absorption. The theoretical spectra indicate that diffusion processes are enhanced by stronger absorption of the incident radiation.
Dissert. Abstr.

N76-33009 Purdue Univ., Lafayette, Ind.
OPTICAL PROPERTIES OF MAGNETIC CRYSTALS Ph.D. Thesis
Hsin-Hsin Chou 1975 133 p
Avail: Univ. Microfilms Order No. 76-20438

The effect of magnetic transition on the optical absorption edge was studied for three antiferromagnetic crystals, MnO, alpha-MnS and CoO. MnO shows a red shift whereas alpha-MnS and CoO show a blue shift. Light scattering in these crystals was also studied in the temperature range from 6 to 300K. The spectra showed peaks associated with one-magnon and two-magnon excitation. These structures diminished with increasing temperature, becoming unobservable above the Neel temperature. Polarization of the scattered light was investigated for CoO. Raman scattering due to phonons was observed for MnO. The measured spectra for MnO and alpha-MnS also showed photoluminescence, the spectral position of which was found to be independent of magnon excitations.
Dissert. Abstr.

N76-33010# General Dynamics/Pomona, Calif.
BACKGROUND SPECTRAL RADIANCE AND CONTRAST IN THE NEAR-UV, MID-IR, AND LWIR REGIONS: A COMPILATION OF GENERAL DYNAMICS MEASUREMENT DATA
G. W. Ashley, D. W. Blay, E. O. Buenting, L. Gastineau, G. C. Halterma, F. A. Jepson, R. T. Long, N. H. Prentiss, and L. H. Tanable Jul. 1975 119 p
(TM6-125PH-438) Avail: NTIS HC $5.50

Absolute spectral radiance signatures of several natural backgrounds have been measured in the following wavelength regions: (1) near - UV (0.30 to 0.44 microns), (2) MID - IR (1.5 to 5.4 and 2.0 to 5.4 microns), and (3) LWIR (2 - 13 microns). The infrared data were obtained using an interferometer with high spectral and spatial resolution; the near-UV data were acquired using a dispersive-prism spectrometer. Individual background spectra and spectral contrast plots for spatially adjacent background areas are presented. These contrast plots can be used with target spectra to derive optimized spectral regions of operation for target detection systems. Photographs illustrating the spatial appearance of the various background areas in appropriate wavelength bands are included.
Author

N76-33011*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYTICAL AND EXPERIMENTAL EVALUATION OF A FRESNEL LENS SOLAR CONCENTRATOR
Leon J. Hastings, Steve A. Allums, and Ronald M. Cosby (Ball State Univ.) Aug. 1976 55 p refs
(NASA-TM-X-73333) Avail: NTIS HC $4.50 CSCL 20F

An analytical and experimental evaluation of line focusing Fresnel lenses with application potential in the 200 to 370 C range was studied. Analytical techniques were formulated to assess the solar transmission and imaging properties of a grooves down lens. Experimentation was based on a 56 cm wide, f/1.0 lens. A Sun tracking heliostat provided a nonmoving solar source. Measured data indicated more spreading at the profile base than analytically predicted, resulting in a peak concentration 18 percent lower than the computed peak of 57. The measured and computed transmittances were 85 and 87 percent, respectively. Preliminary testing with a subsequent lens indicated that modified manufacturing techniques corrected the profile spreading problem and should enable improved analytical experimental correlation.
Author

N76-33012*# Montevallo Research Associates, Ala.
RAY-TRACE ANALYSIS OF GLANCING-INCIDENCE X-RAY OPTICAL SYSTEMS Final Report
J. William Foreman, Jr. and Joseph M. Cardone Aug. 1976 35 p refs
(Contract NAS8-32115)
(NASA-CR-149999) Avail: NTIS HC $4.00 CSCL 20F

The results of a ray-trace analysis of several glancing-incidence X-ray optical systems are presented. The object of the study was threefold. First, the vignetting characteristics of the S-056 X-ray telescope were calculated using experimental data

to determine mirror reflectivities. Second, a small Wolter Type I X-ray telescope intended for possible use in the Geostationary Operational Environmental Satellite program was designed and ray traced. Finally, a ray-trace program was developed for a Wolter-Schwarzschild X-ray telescope. Author

N76-33013*# Hughes Aircraft Co., Culver City, Calif. Electro-Optical Div.
SHUTTLE INFRARED TELESCOPE FACILITY (SIRTF) PRELIMINARY DESIGN STUDY Final Report
Aug. 1976 416 p refs
(Contract NAS2-8494)
(NASA-CR-137952) Avail: NTIS HC $11.00 CSCL 20F

An overall picture of the SIRTF system is first presented, including the telescope, focal plane instruments, cryogen supply, shuttle and spacelab support subsystems, mechanical and data interfaces with the vehicles, ground support equipment, and system requirements. The optical, mechanical, and thermal characteristics of the telescope are then evaluated, followed by a description of the SIRTF internal stabilization subsystem and its interface with the IPS. Expected performance in the shuttle environment is considered. Tradeoff studies are described, including the Gregorian versus the Cassegrain telescope, aperture diameter tradeoff, a CCD versus an image dissector for the star tracker, the large ambient telescope versus the SIRTF, and a dedicated gimbal versus the IPS. Operations from integration through launch and recovery are also discussed and cost estimates for the program are presented. D.M.L.

N76-33014# Denver Research Inst., Colo.
DIRECT IMAGE RECONSTRUCTION OF ANOMALIES IN A PLANE VIA PHYSICAL OPTICS FAR FIELD INVERSE SCATTERING
N. Bleinstein 1976 32 p refs
(Contract AT(11-1)-2482)
(COO-2482-2-Rev) Avail: NTIS HC $4.00

It is shown how to process backscattered acoustic data to directly generate the image of an anomaly in a plane, such as an anticline, a syncline or fault. The result is based on a physical optics far field inverse scattering identity. This identity states that a phase and range normalized scattering amplitude is proportional to a function which is unity in the region of the anomaly and zero outside that region. ERA

N76-33015# Naval Electronics Lab. Center, San Diego, Calif.
PHOTODETECTOR CHARACTERIZATION: RESPONSIVITY Final Report, Jul. - Dec. 1975
Cedric Gabriel 7 Jan. 1976 40 p refs
(WF5454560)
(AD-A023245; NELC-TR-1978) Avail: NTIS CSCL 19/1

Measurement techniques for the characterization of photodetectors are developed and described mathematically and a flow chart for one such suggested technique is presented.
Author (GRA)

N76-33016# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.
THE CALIBRATION OF A PENTAPRISM Final Report
Charles P. Reeve and Ralph C. Veale Jan. 1976 33 p refs
(PB-253227/3; NBSIR-76-993) Avail: NTIS HC $4.00 CSCL 20F

The calibration process which is described is fairly simple and requires two mirrors, two autocollimators, and a surface plate. Consideration is given to the effects of small angular errors in both the internal geometry of the pentaprism and the positioning of the pentaprism relative to an autocollimator. An example of the calibration of the important pentaprism parameters is given. A simple statistical test is employed for testing whether the measurement system is in control. GRA

N76-33017# Isomet Corp., Springfield, Va.
TUNABLE FILTERS FOR BACKGROUND REJECTION Final Report, Sep. 1973 - Dec. 1974
Harmon Aronson, Peter Williams, Robert Bonner, Delmar Rader, and M. Fival Mar. 1976 131 p refs
(Contract F33615-74-C-1007; AF Proj. 2001)
(AD-A023623; TR-262; AFAL-TR-75-218) Avail: NTIS CSCL 20/6

The prior work of Dixon, Harris, and Isomet Corp. on the electronically-tunable, collinear-interaction, optical filter was extended with the view toward operation in the infrared spectral range from 0.75 micrometers to 4.0 micrometers. Two filters covering the sub-bands from 0.75 to 1.5 micrometers (Band I) and 1.5 to 2.8 micrometers (Band II) were designed and breadboard models were constructed. A third filter (Band III) covering the range from 2.9 micrometers to 4.0 micrometers was designed; a breadboard model was partly constructed. A versatile electronic driver capable of supplying acoustic drive power to all three filters in several different operating modes including manual tune and swept-wavelength was also developed. Further extension of the tunable filter spectral range from 4 to 14 micrometers is reported as the result of a research study.
Author (GRA)

N76-33018# ITT Electro-Optical Products Div., Roanoke, Va.
LOW COST FIBER OPTIC CABLE ASSEMBLIES FOR LOCAL DISTRIBUTION SYSTEMS Semiannual Report, 1 May - 1 Nov. 1975
T. L. Reed and A. R. Asam Feb. 1976 56 p
(Contract DAAB07-75-C-1328; DA Proj. 1S7-62705-AH-94)
(AD-A022651; ECOM-75-1328-1; SAR-1) Avail: NTIS CSCL 20/6

This report describes progress during the first six months of a one year effort to develop a low cost fiber optic cable using plastic clad silica fibers. As part of the program, silica core and plastic cladding materials have been evaluated with respect to optical attenuation, mechanical properties, chemical properties, and radiation hardness. Fabrication techniques have been developed and means to minimize excess cable loss evaluated. Uncabled fibers have been fabricated with attenuations as low as 5.5 dB/km at .79 micrometers. GRA

N76-33019# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INTEGRATED OPTICAL CIRCUITS Semiannual Technical Summary Report, 1 Jan. - 30 Jun. 1975
Charles E. Hurwitz 30 Jun. 1975 15 p refs
(Contract F19628-73-C-0002; ARPA Order 2074)
(AD-A022695; ESD-TR-75-238) Avail: NTIS CSCL 20/6

Attenuation measurements in epitaxial n-GaAs waveguides of different purity show that losses of -2/cm can be achieved at energies within 50 meV of the band edge using material with N sub D - N sub A + or - 2 x 10 to the 15th/cu cm. The electroabsorption coefficient of low-loss GaAs waveguides has been measured in uniform electric fields at wavelengths from 0.91 to 0.93 micrometers. Electroabsorption detectors and modulators have been integrated into these waveguides. A Schottky-barrier electroabsorption modulator has been combined with a GaAs-AlGaAs laser integrated into a high-purity GaAs waveguide to form a completely integrated IOC source. PbSnTe liquid-phase epitaxial layers have been grown on top of lambda/2 gratings fabricated in PbTe to form PbSnTe heterostructure distributed feedback laser structures. Author (GRA)

N76-33020# Optical Science Consultants, Yorba Linda, Calif.
THEORETICAL STUDY ON NON-STANDARD IMAGING CONCEPTS Final Technical Report, 15 Feb. - 15 Aug. 1975
David L. Fried Mar. 1976 187 p refs
(Contract F30602-74-C-0115; ARPA Order 2646; AF Proj. 2646)
(AD-A023627; DR-048; RADC-TR-76-51) Avail: NTIS CSCL 20/6

This report is separated into two parts. Part I presents the analytic backup and computer code results of an effort to generate a fairly general computer code that would allow calculation of a variety of standard optical propagation effects. These effects are concerned with imaging resolution, heterodyne reception, laser transmitter antenna gain, scintillation, predetection compensation, etc. The computer program is written in Extended BASIC and can be run on a 16K memory size NOVA-type computer. Sample calculations are presented. Part II of the report is concerned with the subject of isoplanatism and its measurement. It is demonstrated that the isoplanatic patch size will, in general, not be the same for predetection compensation and for ordinary short-exposure imagery. The concept of angle-of-arrival isoplanatism is introduced and a simple integral expression relating the

distribution of C sub N sq to angle-of-arrival isoplanatism is developed. The procedure for inverting a set of measurements of the angle-of-arrival isoplanatism function to obtain the distribution of C sub n square, and from that calculating the predetection compensation isoplanatism function is studied. Details of the procedure and formulation of its noise sensitivity are presented. Using sample angle-of-arrival isoplanatism measurements made against the edge of the sun, the predetection compensation isoplanatism function is evaluated as well as its rms uncertainty. GRA

N76-33021# Washington Univ., St. Louis, Mo. Applied Electronic Sciences Lab.
GARNET FILM OPTICS Final Report, 1 Feb. 1973 - 30 Jun. 1975
M. W. Muller Jan. 1976 131 p refs
(Contract N00014-67-A-0445-0005; NR Proj. 009-002)
(AD-A023234; Rept-1976-1) Avail: NTIS CSCL 20/6

This report summarizes all the work carried out under the contract. Most of the details have been described in technical reports issued earlier. Topics not discussed elsewhere and covered here include: The technology and characterization of Bi-substituted garnet films designed to produce large Faraday rotation; A revised and improved technique for measuring refractive indices and propagation properties of multilayer waveguides; Extensions of the theory, and design calculations for nonreciprocal waveguide devices; The use of liquid crystals as anisotropic layers; Measurements on component parts of the proposed waveguide optical gyrator structure. GRA

N76-33022# RCA Labs., Princeton, N.J.
CHANNEL WAVEGUIDE STUDY Quarterly Technical Report, 4 May - 3 Aug. 1975
J. M. Hammer, W. Phillips, and C. C. Neil 3 Sep. 1975 15 p refs
(Contract N00014-75-C-0078; ARPA Order 2327)
(AD-A023475; PRRL-75-CR-47) Avail: NTIS CSCL 20/6

In this report we discuss some of the experimental measurements made on passive directional couplers. These measurements are designed to help check the accuracy of the processing used in formation of these devices and indicate a large degree of uncertainty in dimensions caused by both the process used in forming the Nb patterns, and in subsequent diffusion of these patterns. Author (GRA)

N76-33023# RCA Labs., Princeton, N.J.
FIBER-OPTIC SWITCH STUDY Final Report, 18 Nov. 1974 - 17 Sep. 1975
J. M. Hammer, R. A. Bartolini, A. Miller, and C. C. Neil Feb. 1976 63 p refs
(Contract N00014-75-C-0436)
(AD-A023034; PRRL-75-CR-76) Avail: NTIS CSCL 20/6

The principle of operation of fiber-to-planar-waveguide grating couplers has been established experimentally and theoretically. Initial experiments yielded coupling fractions up to 6% and showed the expected angular behavior. Further development of fiber-planar waveguide grating couplers should allow the coupling of single-mode fibers to single-mode planar guides with efficiencies that approach 90%. Multimode fibers may also be coupled but with reduced efficiencies which depend on the acceptable angular spread of the coupled beams. Author (GRA)

N76-33024# Army Electronics Command, Fort Monmouth, N.J.
IMPROVEMENTS IN LONG PATH ABSORPTION CELL MEASUREMENTS
Wendell R. Watkins Mar. 1976 39 p refs
(DA Proj. 1T0-61102-B-53A)
(AD-A023079; ECOM-5586) Avail: NTIS CSCL 20/6

Improvements which greatly reduce the data acquistion time and increase the accuracy of long-path absorption cell measurements upon which the choice and further development of many Army laser-based systems depend are discussed. Path differencing, a new technique for measuring absorption coefficients, is described. Path differencing effectively gives the massive cells and intricate optical and detection systems used in long-path absorption cell experiments the real-time calibration of double-beam spectrometer systems. This calibration results in a factor of 4 to 5 in improvement in reproducibility. Techniques of weighted averages are discussed for obtaining best fit absorption data, and a detection and correction scheme for system nonlinearities is given. A method for determining errors in absorption coefficients from data at different partial pressures of an absorbing gas and characterizing nonlinear pressure dependencies is also included. Author (GRA)

N76-33025# Metavac, Inc., Flushing, N.Y.
PRODUCTION ENGINEERING MEASURES FOR FILTER, INFRARED, INTERFERENCE-ABSORPTION TYPE Quarterly Report, 1 Sep. - 30 Nov. 1975
John Monte 10 Jan. 1976 20 p
(Contract DAAB07-74-C-0379; DA Proj. 2749523)
(AD-A023604; QR-6) Avail: NTIS CSCL 20/6

Five First Article filters were assembled and put through some tests during this period. Results are discussed. GRA

N76-33026# Frankford Arsenal, Philadelphia, Pa.
FABRICATION AND TESTING OF LONG WAVELENGTH OPTICAL MATERIALS AND COMPONENTS
Joseph P. Jacobson, Richard I. Cook, J. R. Goldgraben, and Frank J. Sama Aug. 1975 58 p refs
(AD-A023176; FA-TR-75068) Avail: NTIS CSCL 20/6

The effort in this program was directed towards two primary objectives. The first was to study the problems associated with the definition, assessment and maintenance of quality in infrared optical elements and to recommend suitable test and evaluation procedures. The second was to document the procedures employed by the Frankford Arsenal for the grinding and polishing of germanium lenses. Based on a survey of recent literature and on conversations with lens fabricators and optical equipment manufacturers, optical quality for imaging and non-imaging systems has been defined in terms of specific performance criteria and physical parameters. Techniques and equipment which represent the current state-of-the-art and which are suitable for obtaining quantitative and objective measurements of the various aspects of optical quality in a production process have been identified. A draft specification for optical quality germanium is included. Personnel of the Frankford Arsenal optical shop were interviewed to document the equipment, material and procedures which are currently in use at Frankford Arsenal for the fabrication of germanium lenses. Author (GRA)

N76-33027# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
POLARIZATION MATRICES AND OPTICAL DIFFRACTION THEORY Final Report
Richard Barakat 28 Feb. 1976 10 p
(Contract F44620-72-C-0063; AF Proj. 9751)
(AD-A023049; AFOSR-76-0293TR) Avail: NTIS CSCL 20/6

The research in this effort was mainly concerned with various topics in theoretical optics. Six separate areas were investigated. The first is photoelectrion counting statistics. A long review article was published in this area. Second, laser speckle patterns were studied. These speckle patterns are intrinsically statistical in nature and a knowledge of their statistical properties is of considerable interest as they often represent the limiting constraint on imaging. Third, inversion problems in optical physics were investigated. The problem concerns the subject of object restoration whereby the diffraction image and the optical system are given and are required to find the object. Optical diffraction theory in the presence of random wavefronts was investigated. Analysis was extended to the effects of random wavefronts on imaging systems by including (1) random amplitudes in addition to random phase errors, (2) an explicit time dependence of the random wavefront errors in the form of a translating frozen atmosphere, (3) temporal behavior of the transfer function. The theory of polarization was investigated and a small monograph was published. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N76-33028 California Univ., Davis.
A COUPLED MHD-MONTE CARLO TRANSPORT MODEL

FOR DENSE PLASMAS Ph.D. Thesis
William Paul Chandler 1976 104 p
Avail: Univ. Microfilms Order No. 76-20983

A two-dimensional, two fluid model of the MHD equations was coupled to a Monte Carlo transport model of high energy, non-Maxwellian ions. The MHD part of the model assumes complete ionization and includes a perfect gas law for a scalar pressure, a tensor artificial viscosity, electron and ion thermal conduction, electron-ion coupling, and a radiation loss term. The MHD equations were solved in Lagrangian coordinates. The conservation equations were differenced explicitly and the diffusion-type equations implicitly using the splitting technique. The Monte Carlo model solves the equation of motion for high energy ions, moving through and suffering small and large angle collisions with the fluid Maxwellian plasma. The source of high energy ions is the thermonuclear reactions of the hydrogen isotopes, or it may be an externally injected beam of neutralized ions. Dissert. Abstr.

N76-33029 Michigan Univ., Ann Arbor.
ELECTRON THERMAL CONDUCTION IN LASER FUSION PLASMAS Ph.D. Thesis
Gregory Allen Moses 1976 231 p
Avail: Univ. Microfilms Order No. 76-19198

A plasma hydrodynamic simulation computer code was developed using a one dimensional (planar, cylindrical, and spherical), one fluid, and two temperature (electron and ion) plasma model. Thermal conductivity of electrons and ions, electron-ion coupling, PdV work, and bremesstrahlung radiation loss are included in the model as well as ideal gas equations of state. Energy addition via absorption of laser light is included as a source term in the electron temperature equation. The careful observance of advanced programming concepts allows this computer code to be a convenient 'testing bench' for particular problems associated with laser fusion. The specific problem addressed in this dissertation is electron thermal conduction. Dissert. Abstr.

N76-33030*# United Technologies Research Center, East Hartford, Conn.
THE SPECTRAL PROPERTIES OF URANIUM HEXAFLUORIDE AND ITS THERMAL DECOMPOSITION PRODUCTS
Nicholas L. Krascella Sep. 1976 75 p refs
(Contract NAS1-13291)
(NASA-CR-145047; R76-912208) Avail: NTIS HC $4.00 CSCL 20I

This investigation was initiated to provide basic spectral data for gases of interest to the plasma core reactor concept. The attenuation of vacuum ultraviolet (VUV) radiation by helium at pressures up to 20 atm over path lengths of about 61 cm and in the approximate wavelength range between 80 and 300 nm was studied. Measurements were also conducted to provide basic VUV data with respect to UF6 and UF6/argon mixtures in the wavelength range between 80 and 120 nm. Finally, an investigation was initiated to provide basic spectral emission and absorption data for UF6 and possible thermal decomposition products of UF6 at elevated temperatures. Author

N76-33031*# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF APPLICATIONS FOR HIGH-POWER, SELF-CRITICAL FISSIONING URANIUM PLASMA REACTORS Final Technical Report
Richard J. Rodgers, Thomas S. Latham, and Nicholas L. Krascella Sep. 1976 90 p refs
(Contract NAS1-13291)
(NASA-CR-145048; R76-912204) Avail: NTIS HC $5.00 CSCL 20I

Analytical studies were conducted to investigate potentially attractive applications for gaseous nuclear cavity reactors fueled by uranium hexafluoride and its decomposition products at temperatures of 2000 to 6000 K and total pressures of a few hundred atmospheres. Approximate operating conditions and performance levels for a class of nuclear reactors in which fission energy removal is accomplished principally by radiant heat transfer from the high temperature gaseous nuclear fuel to surrounding absorbing media were determined. The results show the radiant energy deposited in the absorbing media may be efficiently utilized in energy conversion system applications which include (1) a primary energy source for high thrust, high specific impulse space propulsion, (2) an energy source for highly efficient generation of electricity, and (3) a source of high intensity photon flux for heating working fluid gases for hydrogen production or MHD power extraction. Author

N76-33032*# United Technologies Research Center, East Hartford, Conn.
LABORATORY-SCALE URANIUM RF PLASMA CONFINEMENT EXPERIMENTS Final Report
Ward C. Roman Sep. 1976 194 p refs
(Contract NAS1-13291)
(NASA-CR-145049; R-76-912205) Avail: NTIS HC $7.50 CSCL 20I

An experimental investigation was conducted using 80 kW and 1.2 MW RF induction heater facilities to aid in developing the technology necessary for designing a self-critical fissioning uranium plasma core reactor. Pure uranium hexafluoride (UF6) was injected into argon-confined, steady-state, RF-heated plasmas in different uranium plasma confinement tests to investigate the characteristics of plamas core nuclear reactors. The objectives were: (1) to confine as high a density of uranium vapor as possible within the plasma while simultaneously minimizing the uranium compound wall deposition; (2) to develop and test materials and handling techniques suitable for use with high-temperature, high-pressure gaseous UF6; and (3) to develop complementary diagnostic instrumentation and measurement techniques to characterize the uranium plasma and residue deposited on the test chamber components. In all tests, the plasma was a fluid-mechanically-confined vortex-type contained within a fused-silica cylindrical test chamber. The test chamber peripheral wall was 5.7 cm ID by 10 cm long. Author

N76-33033# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands).
HYDROGEN AND HELIUM DENSITY PROFILES IN A STEADY-STATE GAS-BLANKET REACTOR
J. A. Markvoort Nov. 1975 112 p refs Sponsored by Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek (ZWO) and Euratom
(NP-20761; Rept-75-91) Avail: ERDA Depository Libraries HC $5.50

A steady-state DT gas-blanket reactor is analyzed. The behavior of the plasma in the reactor, consisting of electrons, a 50/50 deuterium-tritium mixture, and helium, is described by the multifluid MHD-equations. The set of equations differs in one important aspect from the usual ones as the thermoelectric forces arising from both electron-ion and ion-ion collisions are taken into account. The equations are numerically solved with the aid of a Runge Kutta method. The formula of Braginskii for the so-called Nernst effect, which only considers the electron-ion collisions, is generalized to include collisions between ions with arbitrary charges and masses. It is shown that the influence of the thermoforce due to ion-ion collisions on the density profiles is larger than the force due to the electron-ion collisions. Case studies were made to evaluate the effect of the Nernst thermoforce on simple hydrogen arcs, which are ohmically heated. Author (NSA)

N76-33034# Max-Planck-Institut fuer Plasmaphysik, Munich (West Germany).
BELT PINCH: A HIGH-BETA TOKAMAK WITH NON-CIRCULAR CROSS-SECTION
O. Gruber, J. M. Peiry, and R. Wilhelm Oct. 1975 44 p
(IPP-1/156) Avail: ERDA Depository Libraries HC $4.00

In a Tokamak the attainable beta values are restricted by the limitations of MHD stability. But the necessary improvement of the beta value should be possible by the transition to a noncircular plasma cross-section. The theoretical conditions for such an improvement are discussed (e.g., volume currents peaked on axis, flattened ends of the elongated cross-section and diamagnetic plasma). Experimental investigations of this problem were carried out in the Belt Pinch, where plasma production and heating is achieved by fast magnetic compression. This heating method is unusual for a Tokamak, but is for the present the only way to approach the interesting beta regime (<beta>

approximately 10-50%) and especially beta sub pol > 1 operation. Author (NSA)

N76-33035# Brigham Young Univ., Provo, Utah. Dept. of Physics and Astronomy.
STUDIES OF CHARGED PARTICLE DISTRIBUTIONS IN AN ELECTROSTATIC CONFINEMENT SYSTEM Progress Report, 1 Nov. 1971 - 31 Jan. 1976
A. L. Gardner 1976 14 p refs
(Contract AT(11-1)-2180)
(COO-2180-7) Avail: NTIS HC $3.50

Microwave cavity techniques were used to measure electron density in a spherical, inertial-electrostatic confinement device using six ion guns. The density was roughly proportional to ion current and decreased somewhat with increasing ion energy. With D2 pressure decrease from 10 to 3 mTorr, n/sub e/ decreased faster than linearly and below approximately 3 mTorr decreased linearly with pressure down to the lowest pressure of 0.4 mTorr. Six- vs. three-gun operation showed a small enhancement of both n/sub e/ and neutron flux that may indicate some particle trapping. NSA

N76-33036# Princeton Univ., N.J. Plasma Physics Lab.
DISCRETE COIL TORUS WITH LOWER FIELD RIPPLE
G. V. Sheffield Oct. 1975 9 p ref
(Contract E(11-1)-3073)
(MATT-1166) Avail: NTIS HC $4.50

A new toroidal field coil configuration is described which allows one to reduce the volume of a toroidal field coil system or the number of coils constituting such a system without increasing the toroidal field ripple. Author (ERA)

N76-33037# Princeton Univ., N.J. Plasma Physics Lab.
DESTABILIZATION OF THE TRAPPED ELECTRON MODE BY MAGNETIC CURVATURE DRIFT RESONANCES
J. C. Adam, W. M. Tang, and P. H. Rutherford Dec. 1975 24 p refs
(Contract E(11-1)-3073)
(MATT-1156) Avail: NTIS HC $4.00

Electron curvature drift resonances, are found to exert a strong destabilizing influence in the lower collision frequency range of trapped electron mode instabilities. Effects arising from ion temperature gradients, shear, and finite ion gyroradius are included with these vector nebla-drifts in the analysis, and the resultant eigenvalue equation is solved by numerical procedures rather than the commonly used perturbation techniques. For typical Tokamak parameters the maximum growth rates are found to be increased over earlier estimates by roughly a factor of 4, and requirements on magnetic shear strength for stabilization are likewise more severe and very difficult to satisfy. For inverted density profiles, this new destabilizing effect is rendered ineffective, with the result that the modes can be stabilized for achievable values of shear provided the temperature gradients are not too severe. Estimates of the particle and thermal energy transport are given for both normal and inverted profiles. Author (ERA)

N76-33038# Avco-Everett Research Lab., Everett, Mass.
PRODUCTION OF HIGH DENSITY UNIFORM PLASMAS Annual Report
D. H. Douglas-Hamilton, S. A. Mini, and R. M. Patrick Nov. 1975 46 p refs
(Contract F44620-75-C-0025; AF Proj. 6813; AF Proj. 9752)
(AD-A023239; AFOSR-76-0188TR) Avail: NTIS CSCL 20/9

The electron beam sustainer method of generating a stable high pressure gas discharge is investigated theoretically and experimentally. The most important discharge instability in the non-self-sustaining discharge is the streamer; this is discussed and a model proposed for formation and propagation. Integration of streamer velocity over the discharge gap predicts arcing times. Experimental measurements of streamer behavior in nitrogen discharge have been made, and these are compared with predictions. GRA

N76-33039*# Stanford Univ., Calif. Inst. for Plasma Research.
INFLUENCE OF MAGNETIC FIELD STRUCTURE ON THE CONDUCTION COOLING OF FLARE LOOPS
S. K. Antiochos and P. A. Sturrock Mar. 1976 21 p refs
(Grant NGL-05-020-272; Contract N00014-75-C-0673)
(NASA-CR-148864; AD-A022948; SU-IPR-656) Avail: NTIS HC $3.50 CSCL 19/1

A simple model facilitates calculation of the influence of magnetic field configuration on the conduction cooling rate of a hot post-flare coronal plasma. The magnetic field is taken to be that produced by a line dipole or point dipole at an arbitrary depth below the chromosphere. For the high temperatures (T greater than or equal to 10 to the 7th power K) produced by flares, the plasma may remain static and isobaric. The influence of the field is such as to increase the heat flux (per unit area) into the chromosphere, but to decrease the total conduction cooling of the flare plasma. This leads to a significant enhancement of the total energy radiated by the flare plasma. Author (GRA)

N76-33040# Cornell Univ., Ithaca, N.Y.
PLASMA HEATING AND CONFINEMENT WITH HIGH CURRENT RELATIVISTIC ELECTRON BEAMS IN A TORUS Final Report
Bruce R. Krusse Jan. 1976 44 p refs
(PB-252461/9; EPRI- 108-FR) Avail: NTIS HC $4.00 CSCL 20I

An injection problem and the various suggestions for its solution are described. Descriptions are also given of the zero-order drift trajectories in straight and toroidal geometry, including analytical and experimental results; injection and trapping of the beam in the race track filled with neutral gas, including observations of plasma heating; a set of experiments on injection and trapping of the beam in the race track containing a preionized plasma column; the results are summarized and the conclusions discussed with regard to the overall question of plasma confinement and heating by the beam. GRA

N76-33041# Stanford Univ., Calif. Inst. for Plasma Research.
A NEW APPROACH TO THE STUDY OF PLANAR PLASMA PINCH STABILITY Progress Report
Robert J. Barker and Oscar Bruneman Jul. 1975 50 p refs
(Grant NSF ENG-73-03722)
(PB-252699/4; SU-IPR-635) Avail: NTIS HC $4.00 CSCL 20I

The necessary ground work for a systematic study of the stability of current-sheared (plywood model) planar, plasma pinches is presented. Details of a finite-element optimization scheme to incease the efficiency of the simulation are also provided. GRA

N76-33042# Pennsylvania Univ., Philadelphia. Dept. of Mechanical Engineering and Applied Mechanics.
ON THE STABILITY OF ELECTRIC ARC DISCHARGES Interim Report
A. M. Whitman, P. S. Ayyaswamy, and I. M. Cohen Dec. 1975 31 p refs Submitted for publication
(PB-250962/8; MEAM-75-8; EPRI-RP378-1/2) Avail: NTIS HC $4.00 CSCL 20I

A model for the interruption process in variable property electric discharges that is based on an energy balance was developed. In order to facilitate the study of interruption, a new model for the electrical conductivity function was proposed. Asymptotic solutions for the arc governing equations were obtained. Interruption criteria were developed through stability analyses of the steady solutions. These analyses were undertaken from both the linear theory (infinitesimal size disturbance) and from a minimizing solution point of view for finite size disturbances. The results delineate an open region in the stability diagram where arc instabilities may be possible. GRA

N76-33043# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A KINETIC EQUATION FOR HIGH DENSITY, HIGH TEMPERATURE PLASMAS Ph.D. Thesis
John A. Decaire Sep. 1975 102 p refs
(AF Proj. 4150)
(AD-A023003; DS/PH/75-02) Avail: NTIS CSCL 20/9

A new analytical procedure to describe plasma kinetic theory is developed. The analysis is based on the Wigner phase space formulation of quantum statistical mechanics and its associated Bogoliubov-Born-Green-Kirkwood-Yvon (BBGKY) hierarchy of equations for q-body (q = 1,2, ...) correlation clusters. Extensive

use is made of diagrammatic perturbation analysis, operator-state space methods, and the convenient 'bra-ket' notation. Parameters that are physically descriptive of interaction strength, many-body nature, and quantum statistical effects are introduced for ordering analysis of 'relevant' kinetic contributions. GRA

N76-33044# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ON FORMING CYLINDRICAL GAS SHELLS IN ELECTRODE GAPS FOR ELECTROMAGNETIC IMPLOSION PLASMA GENERATION Final Report
James H. Degnan and Robert E. Reinovsky Mar. 1976 98 p refs
(AF Proj. 8809)
(AD-A022712; AFWL-TR-75-265) Avail: NTIS CSCL 20/9

The design concept of a puffed gas electromagnetic implosion plasma generator is briefly discussed. Experimental investigations of the feasibility of producing reasonably well defined cylindrical gas shells in an electrode gap are reported. In these investigations, an exploding plug puff valve developed by I. Henins and J. Marshall was used to puff gas into a 35 cm radius, 2.4 cm long electrode gap. Transient gas density measurements were made for A and Nitrogen puffing using 6AH6 fast response ionization gauges. Such measurements indicate that gas shells with mass and radial confinement suitable for electromagnetic implosion can be produced. Theoretical aspects of the gas puffing are also discussed. Theoretical considerations indicate that the experimental results obtained are reasonable but that nonuniform axial density distributions may be expected (which might distort attempted implosions). Methods for reducing the axial nonuniformity are discussed. GRA

N76-33045# California Univ., Los Angeles. Plasma Physics Group.
THE SPIKY TURBULENCE GENERATED BY A PROPAGATING ELECTROSTATIC WAVE OF FINITE SPATIAL EXTENT
G. J. Morales and V. C. Lee Jan. 1976 65 p refs
(Contract N00014-75-C-0476; Grant NSF MPS-74-15233)
(AD-A023454; PPG-252) Avail: NTIS CSCL 20/9

The excitation of a new type of plasma turbulence consisting of a collection of neighboring localized electric fields of high intensity is investigated. The individual localized fields that constitute the spiky turbulence oscillate at frequencies close to the electron plasma frequency, and their localization is attributed to wave-trapping inside the self-consistent density cavities generated by the total ponderomotive force. Unlike previous investigations of this type of nonlinearity, which have dealt almost exclusively with the effects triggered by electromagnetic radiation, the present work studies the turbulence which is generated by a propagating electrostatic wave of finite spatial extent. This type of pump wave may arise naturally in beam-plasma experiments or in other situations which lead to a finite amplification region. GRA

N76-33046# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
LOW ENERGY PARTICLE EXPERIMENT Annual Technical Report, 1 Apr. 1975 - 31 Mar. 1976
Edward G. Shelley 25 Mar. 1976 6 p
(Contract N00014-72-C-0234; NR Proj. 323-014)
(AD-A022951; LMSC-D501904) Avail: NTIS CSCL 20/9

This program is directed toward an improved understanding of the sources and energization, transport and loss processes associated with the low-energy (keV) plasmas in the earth's magnetosphere, particularly as they relate to the ionospheric perturbations and ionospheric-magnetospheric coupling. A low-energy particle experiment is planned for flight on the polar-orbiting Air Force S3-3 (STP 74-2) satellite. Author (GRA)

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N76-33047 Tufts Univ., Boston, Mass.
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS INTO HIGH POWER Q-SWITCHED Nd (3+) CRYSTAL LASERS Ph.D. Thesis
Jacek Adam Mroczkowski 1976 164 p
Avail: Univ. Microfilms Order No. 76-19598

A system was constructed for the efficient short pulse pumping of a Nd(+3) YALO laser by prepulsing a flashlamp before the main discharge pumping pulse. A new method of flashlamp triggering was incorporated into this system. In the prepulse mode of operation, using an elliptical pumping cavity with one wide diameter 10 mm rare-gas filled flashlamp, xenon pumping was found superior to krypton pumping above the 35 joule input level. An improved laser efficiency was obtained when the flashlamp was prepulsed. An investigation of the Nd(+3) 4f3 multiplet splittings in YAG was undertaken on the basis of a ligand point-charge model. A fit between optical data and calculated splittings of 20 energy levels of different multiplets was made. Some of the methods and results of the crystal field calculations were then used to estimate the feasibility of electric quadrupole shifting of the levels responsible for the 1.064 micron emission in Nd(+3) YAG. Dissert. Abstr.

N76-33048 Notre Dame Univ., Ind.
DETERMINATION OF THE ENERGY GAP AND TRANSITION TEMPERATURE OF SUPERCONDUCTING HEXAGONAL LANTHANUM BY ELECTRONIC TUNNELING Ph.D. Thesis
Seung-ok Hong 1976 128 p
Avail: Univ. Microfilms Order No. 76-19467

Thick La films (0.2-1.5 micrometers) prepared in dry vacuum ambients by evaporation onto cooled glass substrate (approximately 100K) were investigated by means of tunneling and resistance measurements at temperatures between 0.9 and 6.2K. The results suggest that the films consist of pure La predominantly in the dhcp phase, a conclusion consistent with X-ray information obtained with a film prepared under similar conditions. Tunneling values of the energy gap obtained with 36 junctions resulting from 33 independent fabrications yield an average value delta (La) = 0.799 (+ or - 0.013) meV which agrees with the bulk specific heat value 0.770 (+ or - 0.046) meV. Tunneling measurements obtained with a selected subset of five junctions support the view that La is a strong-coupling superconductor. Mean free path L determinations obtained from the type II behavior of these La films fall in the range the smallness of L presumably resulting from deposition onto cold substrates. Dissert. Abstr.

N76-33049 Oregon Univ., Eugene.
ELECTRON SCATTERING RATES IN BISMUTH ALLOYS IN MAGNETIC FIELDS NEAR THE QUANTUM LIMIT Ph.D. Thesis
Jonathan Pace Rode 1976 179 p
Avail: Univ. Microfilms Order No. 76-19390

Measurements of quasi-particle scattering rates were made for both holes and electrons using the de Haas-van Alphen (dHvA) effect near the quantum limit (QL). The near-QL is the region of magnetic field for which all the conduction electrons are condensed onto a few discrete quantum mechanical energy levels (Landau levels). This regime of magnetic field may be reached only in metals which have very small pieces of Fermi surface (generally corresponding to low carrier concentration). In Bismuth, a semimetal with .00001 free electrons per atom, the QL is achieved in magnetic fields of 5-100 kG, depending on crystal orientation. A calculation of scattering in the quantum limit was performed. A mathematical expression was developed which predicts an exponential dependence of the amplitude of the magnetization oscillations on the scattering rate. Extremely pure, low strain crystals were grown using a horizontal zone refining and crystal growth apparatus designed for growing pure metals and dilute alloys. Results are presented and discussed in detail.
Dissert. Abstr.

N76-33050 Cornell Univ., Ithaca, N.Y.
AN ELECTRON SPIN RESONANCE STUDY OF ROTATIONAL REORIENTATION AND SPIN RELAXATION IN LIQUID CRYSTAL MEDIA Ph.D. Thesis
Carl Francis Polnaszek 1976 618 p

Avail: Univ. Microfilms Order No. 76-21121

The stochastic Liouville method is extended to obtain electron spin resonance ESR lineshapes for nitroxide radicals in the slow tumbling region for fluid systems in which the molecular environment is anisotropic. A detailed experimental study of the deuterated nitroxide PDT in several nematic liquid crystals was performed. The results in both the isotropic and nematic phases and in the motional narrowing and incipient slow tumbling regions are analyzed in terms of the theories presented. Anomalous lineshpae behavior in the incipient slow tumbling region is observed and can be interpreted as arising from slowly fluctuating intermolecular torques or from fluctuations in the local structure (order) parameter which may persist over periods longer than the correlation time for rotational reorientation of the spin probe. Dissert. Abstr.

N76-33051 Mississippi Univ., University.
ELECTROMAGNETIC SCATTERING FROM ARBITRARILY-SHAPED LOSSY DIELECTRIC BODIES Ph.D. Thesis
Te-kao Wu 1976 187 p
Avail: Univ. Microfilms Order No. 76-20540

The scattering properties of a two-dimensional dielectric cylinder and a three-dimensional dielectric body of revolution were studied using surface type integral equations and eigenfunction expansion. To test the validity of this method, homogeneous circular cylinders and spheres were first studied. The results thus obtained by the integral equation technique showed excellent agreement with the eigenfunction expansion solutions. Surface fields or currents on elliptical cylinders and cone-sphere bodies are presented to illustrate the applicability of the integral equation solutions to arbitrary geometries. Radar scattering patterns are then given for the above cylinders and bodies of revolution, as well as other structures. Field plots throughout the interior are also given for single-layered and more complex cylinders. The surface integral equation technique can constitute a useful tool for pattern analyses and diagnostics of microwave hazards in biological tissues. Dissert. Abstr.

N76-33052 Catholic Univ. of America, Washington, D.C.
SUSCEPTIBILITY AND HEAT CAPACITY OF MAGNETIC CRYSTALS WITH RARE-EARTH DOPING UNDER THE INFLUENCE OF DIPOLE-DIPOLE FORCES Ph.D. Thesis
Richard Gaines Lockhart 1976 134 p
Avail: Univ. Microfilms Order No. 76-20230

The interaction between the magnetic moments of the rare earth ions in a dielectric crystal is given by the classical dipole dipole interaction. The first few terms in the high temperature expansion of the heat capacity of entropy and the magnetic susceptibility were computed for a number of cases: crystals with one or two magnetic ions per unit cell and diagonal g factors. Using the same hypothesis one can also determine the ground state using the Luttinger Tisza method. Rare earth compounds such as double magnesium nitrates, tri-chlorides, ethylsulfates, hydroxides, and phosphates were used. The assortment of compounds required a more general FORTRAN program employing a direct lattice summation technique. Calculations were extended to systems with an arbitrary number of magnetic ions per unit cell and with g-tensors of arbitrary orientation. Author

N76-33053 Catholic Univ. of America, Washington, D.C.
CRITICAL POINTS FOR A METAMAGNETIC ISING MODEL USING A CONSTANT COUPLING APPROXIMATION Ph.D. Thesis
William Carl Stamm 1976 105 p
Avail: Univ. Microfilms Order No. 76-19706

A metamagnet, such as FeCl2, FeBr2 or DAG, can be approximated by an Ising spin model with antiferromagnetic and ferromagnetic coupling in the Hamiltonians. The properties of such a system are determined using a form of the constant coupling approximation based on two-particle clusters. The second-order phase line, a series of Neel points in the H sub s = 0 plane, is calculated assuming a set of coupling constants and coordination numbers. Two sets of isotherms are calculated to determine the location of the various critical points. These isotherms and other phase lines were obtained by numerical solution of the self-consistency relations. The criteria for the second-order phase lines and tri-critical point are discussed from considerations of critical point behavior and the geometrical behavior of the isotherms in the region near the high-order critical points. These two methods yielded equivalent results. Dissert. Abstr.

N76-33054 New York Univ., N.Y.
A THEORY OF PHASE TRANSITIONS IN STRUCTURALLY COMPLEX CRYSTALS Ph.D. Thesis
Alfred Kwasi Agyei 1976 307 p
Avail: Univ. Microfilms Order No. 76-19479

The Landau theory of phase transitions in crystals is reformulated to take account of the site symmetries of the atoms that actually undergo the physical or thermodynamic changes necessary for the occurrence of a given transition in a given crystal. The theory is applied to and successfully used to account for: (1) the displacive structural transition that precedes the superconducting transition in transforming A-15 single crystals; (2) the unit-cell preserving magnetic transitions that have been observed in single crystals of the spinels, the compound UH3, and compounds with the Mn3Pt-type structure. These are structurally complex crystals, and the Landau theory has either never been applied to the transitions occurring in them, or, in the cases in which it has been, it has thus far not been possible to satisfactorily account for the experimentally observed facts. Dissert. Abstr.

N76-33055 Boston Coll., Chestnut Hill, Mass.
RECOILLESS FRACTION MEASUREMENT OF PREMARTENSITIC SURFACE LATTICE INSTABILITY Ph.D. Thesis
Jeffrey Hayden Everson 1976 145 p
Avail: Univ. Microfilms Order No. 76-21212

The primary nucleation of martensitic phase transformations is described in terms of strain induced elastic instabilities of the parent lattice. Potent nucleation sites are postulated to be free surfaces and grain boundaries. It is shown that anharmonic terms in the elastic free energy reduce estimates of the nucleation barrier. Lattice vibrations play an important role in the nucleation process. An experimental program incorporating conversion electrons and gamma rays from the Mossbauer effect is used to test the theory by measuring the recoilless fraction at the surface and volume of iron nickel alloys. Results indicate that, although the surface region is considerably more unstable than the sample volume, the volume region transforms a greater fraction of the parent lattice to martensite than does the surface region at the same temperature. Dissert. Abstr.

N76-33056 California Univ., Irvine.
SOME PROBLEMS OF LATTICE DYNAMICS AT CRYSTAL SURFACES Ph.D. Thesis
David Jung-Sung Cheng 1976 253 p
Avail: Univ. Microfilms Order No. 76-19621

A theoretical investigation of force constant changes and mean-square displacements in the vicinity of a crystal surface is presented and applied to the (001) and (110) surfaces of a body-centered cubic crystal using a general lattice dynamical model consisting of Lennard-Jones 6-12 type central potential interactions up to fourth neighbors together with non-central angular stiffness interactions among three consecutive nearest neighbors. The values of bulk force constants were chosen to give good fits to the bulk phonon dispersion curves in the high symmetry directions 100, 110 and 111. Surface force constant changes due to anharmonicity are calculated for very low temperature and extended to finite temperatures. The influence of surface force constant changes on some lattice dynamical surface properties is discussed. Electronic effects in surface relaxation are also given. Dissert. Abstr.

N76-33057 North Carolina Univ., Chapel Hill.
A STUDY OF THE SUPERCONDUCTING AND PHONON PROPERTIES OF THE DISORDERED GALLIUM-SILVER SYSTEM USING ELECTRON TUNNELING TECHNIQUES Ph.D. Thesis
Richard Norris Brooke, Jr. 1975 112 p
Avail: Univ. Microfilms Order No. 76-20002

Electron tunneling techniques were used to study properties of two metastable phases of gallium as functions of low silver impurity concentration. Conductance measurements were performed on amorphous gallium junctions with silver impurity

concentrations ranging from 0 to 18 atomic percent. Other experimental measurements included the determination of the superconducting transition temperature. From a complicated analysis of the tunneling curves, the effective phonon spectrum, and the Coulomb pseudo-potential were calculated. From the resulting phonon spectrum, a calculated transition temperature was approximated using a model for strong-coupling superconductors. Dissert. Abstr.

N76-33058*# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

EXPERIMENT MA-028 CRYSTAL GROWTH Final Report, 1 Mar. 1974 - 31 Aug. 1976

David M. Lind 31 Aug. 1976 22 p refs

(Contract NAS9-14015)

(NASA-CR-150984; SC583.62FR) Avail: NTIS HC $3.50 CSCL 20B

A crystal growth experiment is reported on orbital space flights. The experiment was performed during the Apollo-Soyuz Test Project. The Crystal Growth Experiment assessed a novel process for growing single crystals of insoluble substances by allowing two or more reactant solutions to diffuse toward each other through a region of pure solvent in zero gravity. The experiment was entirely successful and yielded crystals of about the expected size, quality, and number. Author

N76-33059*# Alabama Univ., Tuscaloosa.

INVESTIGATION OF CRYSTAL GROWTH FROM SOLUTIONS Final Report, 22 Nov. 1971 - 21 Aug. 1975

Ichiro Miyagawa Oct. 1975 231 p refs

(Contract NAS8-28098)

(NASA-CR-150001) Avail: NTIS HC $8.00 CSCL 20B

Growth of organic compounds from solution, in particular Rochelle salt and triglycine sulphate, was investigated. Ground-based experiments showed that gravity-driven convection currents in the growth solution influenced defect production in crystals, degraded ferroelectric quality, and indicated that an experiment done in a zero-gravity environment would be beneficial. A crystal of Rochelle salt was grown on board Skylab-4. The quality of this crystal was compared to earth-grown crystals and its unusual features were studied. A typical defect produced in this convection-free environment was a long straight tube extending in the direction of the c crystal axis. These tubes were much longer and more regularly arranged than in similar earth-grown crystals. The crystal was actually several crystals with corresponding axes parallel to each other. Ferroelectric hysteresis experiments showed that some parts of the crystal had many defects, while other parts were of extremely good quality. Author

N76-33060# Argonne National Lab., Ill.

STRESS DISTRIBUTION IN HELIUM-ION IMPLANTATIONS

B. O. Hall 1976 19 p refs Presented at the 2d Intern. Conf. On Surface Effects in Controlled Fusion Devices, San Francisco, 16 Feb. 1976

(Contract W-31-109-eng-38)

(CONF-760209-11) Avail: NTIS HC $3.50

The stress introduced into a material in a nonenergetic helium-ion implantation is calculated for an ion beam with a Gaussian intensity distribution. An effective beam spot of the order of several millimeters was chosen as typical of blistering experiments. The sample is assumed to be semi-infinite and isotropic. The ion distribution is cylindrically symmetric with a Gaussian depth profile. The parameters defining the distribution are consistent with incident ion energies of approximately 40 and approximately 400 keV in both nickel and niobium. The volume expansion caused by the implanted ions is assumed to be proportional to the local helium concentration; the validity of this assumption is discussed. The maximum shear stress is calculated as a function of depth, and the volume expansion per helium atom required to produce plastic deformation at the experimentally observed critical doses in niobium is found to be of the order of one atomic volume. NSA

N76-33061# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoj Fiziki.

EFFECT OF EXTERNAL CONSTANT MAGNETIC FIELDS ON TWO-MAGNON LIGHT ABSORPTION IN ANTIFERROMAGNETICS

N. A. Sukhorskaya 1975 24 p refs In RUSSIAN

(ITP-75-71R) Avail: ERDA Depository Libraries HC $3.50

The dependence of the intensity and the shape of the two-magnon absorption line (with the magnon-magnon interaction taken into account) on the value and the direction of the electric component intensity of incident light and the external constant magnetic field is investigated. It is shown that for the sufficiently strong fields the appearance of the additional peak and the intensity splash is possible under the general tendency towards the absorption decreasing with the increase of the constant magnon field intensity. ERA

N76-33062# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoj Fiziki.

QUANTUM THEORY OF EXCITON MIGRATION IN CRYSTALS

Yu. B. Gaididei and A. A. Serikov 1975 31 p In RUSSIAN

(ITP-75-66R) Avail: ERDA Depository Libraries HC $4.00

A study is made of the migration processes of electron excitations in a crystal for a case of wide exciton zones. The time evolution of the electron excitations interacting with the oscillations in a crystal lattice is studied. The problems of motion and diffusion of exciton packets are elucidated. Author (ERA)

N76-33063# Akademiya Nauk URSR, Kiev. Inst. Teoretichesko Fiziki.

SPIN-PHONON INTERACTION IN ANTIFERROMAGNETICS

I. M. Grigorashchuk, V. M. Nitsovich, and K. D. Tovstyuk 1975 8 p refs In RUSSIAN

(ITP-75-40R) Avail: ERDA Depository Libraries HC $3.50

The vibrational spectrum and the sound velocity in antiferromagnetics are obtained in the general form in pseudoharmonic approximation with allowance for the anharmonisms of all orders. Starting from experimentally defined dependence of the Debye-Waller factor on the temperature a corollary is put forward that in some antiferromagnetics under the temperature lower than T/subN/ the appearance of the narrow band of paramagnetic states is possible. In antiferromagnetics where the transition metal-dielectric described by the Habbard model is possible this results in the appearance of the additional transition dielectric-metal-dielectric. Author (ERA)

N76-33064# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoj Fiziki.

APPLICATION OF PHENOMENOLOGIC APPROACH TO AN INVESTIGATION OF THE INDUCED GYROANISOTROPIC PHENOMENA IN DIELECTRICS

V. N. Kharkyanen and E. G. Petrov 1975 27 p refs In RUSSIAN

(ITP-75-28R) Avail: ERDA Depository Libraries HC $4.00

A group-theoretical method to obtain the contribution in tensor of transverse dielectrical permeability of magnetic and nonmagnetic dielectrics from specific transitions forbidden in zero approximation in some axial perturbation. The axial perturbation mentioned above permits the transitions and changes the optical symmetry of a crystal in the frequencies of specific transitions depending upon the type of the transition. The external electric and magnetic fields can be chosen as the axial perturbation. This allows one to change the optical symmetry of a crystal in the vicinity of the given transition. Author (ERA)

N76-33065# Rochester Univ., N.Y.

INTERGRANULAR FRACTURE AND DISCLINATION MODEL OF GRAIN BOUNDARIES Final Report, 20 Nov. 1972 - 19 Nov. 1975

J. C. M. Li 1976 14 p refs

(Grants DA-ARO(D)-31-124-73-G77; DAHC04-75-G-0072)

(AD-A022568; ARO-10608.7-MC) Avail: NTIS CSCL 07/4

Results of a study of intergranular fracture using the disclination model of grain boundaries are briefly summarized. Included in the investigation were the energy of high angle grain boundaries as a function of the angle of misfit, the porosity of high angle grain boundaries, the mobility of high angle grain boundaries and the mechanical stability of interfaces. GRA

N76-33066# Office of Naval Research, London (England).
INTERNATIONAL CONFERENCE ON PHONON SCATTERING IN SOLIDS
Thomas A. Kitchens, Jr. 31 Dec. 1975 11 p Presented at 2d Intern. Conf., Nottingham, England, 27-30 Aug. 1975
(AD-A022708; ONRL-C-23-75) Avail: NTIS CSCL 20/8

The Second International Conference on Phonon-Scattering in Solids was held in late August 1975. This report discusses the eleven invited talks and many of the contributed talks given during the four days. The major subjects of this conference included Kapitza boundary resistance, spin-phonon and charge carrier-phonon scattering, and second sound. Author (GRA)

N76-33067# National Bureau of Standards, Boulder, Colo.
PROPERTIES OF NONSUPERCONDUCTING TECHNICAL SOLIDS AT LOW TEMPERATURES: AN UPDATE Final Report
F. R. Fickett 1975 21 p refs Repr. from proceedings of 5th Intern. Conf. on Magnet Technol., Rome, 21-25 Apr. 1975 p 659-678
(PB-252725/7) Avail: NTIS HC $3.50 CSCL 20L

This review presents properties measurements carried out on structural materials, both metallic and nonmetallic, (composites, plastics) at low temperatures. It is a sequel to the paper presented at the preceding conference and, as such, concentrates on measurements reported over the last two years. These years have been a period of intense activity in this field and a great deal of new data have been obtained, particularly on mechanical properties. Specific topics covered are thermal, magnetic, mechanical and fracture properties of materials. A tabular guide to the literature is included. GRA

N76-33068# National Bureau of Standards, Boulder, Colo.
EFFECT OF GROUND-STATE AND EXCITATION POTENTIALS ON ENERGY LEVELS OF Ni METAL Final Report
R. E. Watson, J. F. Herbst, L. Hodges, B. I. Lundqvist, and J. W. Wilkins 9 Jun. 1975 6 p refs Repr. from Physical Review B, v. 13, no. 4, 15 Feb. 1976 p 1463-1467
(Grant NSF DMR-74-23494)
(PB-252724/0) Avail: NTIS HC $3.50 CSCL 20L

Self-consistent energy band calculations for paramagnetic Ni were performed in an effort to compare ground state and excitation potential prescriptions; potentials of the Hartree-Fock-Wigner-Seitz and Hedin-Lundqvist type are examined. The bandwidth and placement of the Fermi level within the bands are found to be rather insensitive to the choice of potential, while the absolute position of the bands with respect to the appropriate reference energy is potential dependent. Use of the Hedin-Lundqvist excitation potential instead of the ground-state potential produces level differences no greater than 0.1 eV. GRA

N76-33069# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
GLOW DISCHARGE OPTICAL SPECTROSCOPY FROM MEASUREMENT ON BORON IMPLANTED DISTRIBUTIONS IN SILICON Technical Report
Gerald Twiggs Marcyk Mar. 1976 54 p refs
(Contract DAAB07-72-C-0259; Grant NSF DMR-73-02359)
(AD-A023441; R-720; UILU-ENG-76-2208) Avail: NTIS CSCL 14/2

Ion implantation has become a common method for introducing impurities into semiconductors. The energy and amount of the impurities can be accurately measured during implantation. This affords a control and reproducibility which cannot be matched by standard diffusion techniques. The implanted atoms come to rest in the substrate with a certain distribution or profile. The impurity profile must be known to take full advantage of ion implantation. The profile is a complex function of impurity mass and energy, substrate, and crystal orientation. Author (GRA)

N76-33070# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoj Fiziki.
SOME CLASS OF PSEUDOPOTENTIALS CONSTRUCTED ON THE BASIS OF COMPLETELY ORTHOGONALIZED PLANE WAVES.
B. A. Gurskii and Z. A. Gurskii 1975 21 p In RUSSIAN
(ITP-75-59R) Avail: ERDA Depository Libraries HC $3.50

The orthogonalized plane wave basis used in the theory of pseudopotential is overcomplete and nonorthonormal. A detailed analysis of the C.O.P.W. basis (completely orthogonalized plane waves) free from these defects was done. The pseudopotential Wcopw was obtained by means of the COPW formalism. In a special case various approximations were obtained, which were the formerly known pseudopotentials. The relations between two classes of pseudopotentials, Wcopw and Wopw, are discussed. ERA

N76-33071# Connecticut Univ., Storrs. Dept. of Physics.
THE LOW TEMPERATURE THERMAL CONDUCTIVITY OF DEFORMED ALUMINUM ALLOYS: SEPARATION OF THE LATTICE AND ELECTRONIC COMPONENTS Interim Report
R. W. Klaffky, N. S. Mohan, and D. H. Damon 1975 11 p refs
(Grant AF-AFOSR-2418-73; AF Proj. 9761)
(AD-A023430; AFOSR-76-0367TR) Avail: NTIS CSCL 20/12

The thermal electrical conductivities of a number of Al-Mg alloys were measured between 1.2 and 55 K. The lattice thermal conductivities were deduced. The intrinsic lattice thermal conductivity of Al was obtained by extrapolation. The effects of dislocations and point defects on the lattice thermal conductivity are discussed. Author (GRA)

N76-33072# Army Electronics Command, Fort Monmouth, N.J.
ELECTRON BEAM-SEMICONDUCTOR POWER ACCUMULATOR
Maurice Weiner Mar. 1976 38 p refs
(DA Proj. 1S7-62705-AH-94)
(AD-A023209; ECOM-4392) Avail: NTIS CSCL 20/12

A feasibility investigation on the combining of power outputs from several electron beam-semiconductor (EBS) diodes, operating Class B, was undertaken. A feasibility model for the 500 - 1000 MHz band was designed, fabricated, and tested. The design makes use of plug-in tubes, each of which is a self-contained, replaceable unit amplifier. Each unit amplifier contains an EBS diode as well as grid modulation and electron gun structures. The design includes impedance matching networks for the input to the grid-cathode, as well as for the diode output. Results demonstrate the feasibility of the device, but additional diode development is required in order for the device to fulfill its potential. Author (GRA)

N76-33073# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE ELECTRONIC STRUCTURE OF METHYL NITRATE. 1: X-RAY PHOTOELECTRON SPECTRA AND PRELIMINARY THEORETICAL STUDIES Final Report
George F. Adams, Jagadesh Sharma (Feltman Res. Labs), and Peter Dibona (Feltman Res. Labs) Mar. 1976 29 p refs
(AD-A023620; BRL-1864) Avail: NTIS CSCL 20/10

Ab initio LCAO-MO-SCF calculations using several basis sets and approximate INDO-MO calculations for methyl nitrate are reported. The eigenvalues and eigenvectors are used to analyze the results of x-ray photoelectron spectroscopic studies of the molecule. Core and valence electron and satellite spectra are reported. Both the theoretical and experimental results indicate that the core electrons are tightly bound in this molecular system. Author (GRA)

N76-33074# California Univ., Irvine.
AN INVESTIGATION OF SOME OPTICAL PROPERTIES OF CRYSTALS AND OF CRYSTAL SURFACES Final Report
A. A. Maradudin Jan. 1976 26 p refs
(Grant AF-AFOSR-2018-71; AF Proj. 9761)
(AD-A023262; AFOSR-76-0151TR) Avail: NTIS CSCL 20/6

Forty two scientific articles detailing the results of this research are abstracted and interrelated. Nine papers deal with the optical properties of solids including; Ab Initio Calculation of Crystal Tensor, Light Scattering, Morphic Effects, Group Theory, and Impurity Induced Absorption. Twenty eight papers deal with surface properties including; Surface Excitations, Spacial Dispersion Effects, Surface Roughness, Thermodynamic Properties, Lattice Dynamics and Edge Modes. Three papers discuss the possibility of the coexistence of Bardeen-Cooper-Schrieffer (BCS) pairing and the Peierls distortion in one-dimensional conducting

systems. Finally two papers reported the results of Raman and Brillouin scattering experiments. The work has wide implications for laser interactions with solids; and, electronic and optical signal processing and transmission. Author (GRA)

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

N76-33075 American Univ., Washington, D.C.
LIGHT SCATTERING TEST OF THE PARAMETRIC EQUATIONS FOR THE THERMODYNAMIC SURFACE OF CARBON DIOXIDE NEAR THE CRITICAL POINT Ph.D. Thesis
Pilwon Kang 1976 157 p
Avail: Univ. Microfilms Order No. 76-19778

A precision light scattering experiment was performed with CO2 to test a parametric equation of the Schofield form, and, in particular, to see if the experiment could discriminate between linear and cubic models. The experiment was carried out within approximately 0.02 deg of the critical point and at the scattering angle of 14 deg. Isothermal profiles of the scattered intensity vs. the vertical position of the fluid were obtained, and from the individual height scans a contour of constant scattered intensity in the (z, T) plane was determined. The experimental result, with an overall accuracy better than approximately 2 percent, may be represented by a contour of constant r of the cubic model. The data were also compared with contours of constant susceptibility generated from linear model systems. Contours generated from these models disagree with one another and with the experimental results by as much as 35 percent. However, by adjusting only the parameter a, the height scale factor, it was possible to bring all these chi-contours into agreement within approximately 1 percent. Dissert. Abstr.

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N76-33076*# New Mexico Univ., Albuquerque.
PROGRAM FOR ADVANCED STUDY IN PUBLIC SCIENCE POLICY AND ADMINISTRATION Final Report
Albert H. Rosenthal Jun. 1976 107 p refs
(Grant NGL-32-044-042)
(NASA-CR-148831) Avail: NTIS HC $5.50

The results and conclusions of the six-year effort concerned with the development and implementation of a university educational program intended to prepare scientists and engineers for upper-level management and administrative positions (as distinct from senior technical positions) were presented. This interdisciplinary program is at the graduate level, leading to a Master of Arts degree, and is given within a Division of Public Administration. Y.J.A.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N76-33077 Texas A&M Univ., College Station.
A STATISTICAL PROCEDURE FOR OPTIMIZATION OF PERT NETWORK SCHEDULING SYSTEMS Ph.D. Thesis
Randall Keith Spoeri 1976 190 p
Avail: Univ. Microfilms Order No. 76-20627

Statistical analysis and optimization of Program Evaluation and Review Technique (PERT) network scheduling systems are described. A technique to allow for network simplification based upon blocks of activity configurations is discussed. Approximation of network completion time distribution and moments based on two points from each activity's completion time distribution is studied, and extended to allow for unequal probability at each percentile. Also, a procedure for optimum allocation of time to project activities when network completion time is to be reduced or compressed is presented. Existing computer programs are modified, tested, and documented. New codes have been prepared as required and combined with the others to facilitate implementation of the total program package. The integrated system incorporating all areas is explained, so as to provide for statistical and optimization analysis of PERT networks. Dissert. Abstr.

N76-33078# Community Development Services, Inc., Seattle, Wash.
GUIDELINES FOR TEAM SCHEDULING AND MANAGEMENT Final Report, 1 Oct. 1972 - 30 Jun. 1976
Robert Jacobson and Roger Parker Oct. 1975 38 p Sponsored by the Wash. State Dept. of Highways, Olympia
(PB-252293/6; RPR-25.5) Avail: NTIS HC $4.00 CSCL 13B

The purpose of this document is to present an effective method by which the scheduling and coordination of the activities of interdisciplinary teams can be carried out. A number of more traditional techniques of project control have not met the unique requirements of scheduling and managing the activities of an interdisciplinary team since the basic logic of task ordering is time sequentiality. Quite a number of the activities of an interdisciplinary team can be carried on simultaneously or at any given time within the projects' period. The system developed uses the principle of 'nested' descriptions of program activities and then proceeds to develop operational procedures. The role of the individual team members as well as the overall project development is described. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N76-33079# California Univ., Berkeley. Lawrence Berkeley Lab.
STANDARDS FOR MULTILATERAL AND WORLD-WIDE EXCHANGE OF GEOTHERMAL DATA, APPENDIX 1
J. J. Herr, S. L. Phillips, S. R. Schwartz, and T. G. Trippe 1975 13 p refs Sponsored by ERDA
(UCID-3792) Avail: NTIS HC $3.50

Standards for the exchange of machine-readable data are discussed at five levels covering: (1) physical characteristics of the medium used in the exchange, (2) overall structure of the data file, (3) format of individual records, (4) types of information contained in a record, and (5) authority files for information definition. The standards are used by the National Geothermal Information Resource for compilations of geothermal energy data. Author (ERA)

N76-33080# Ohio State Univ., Columbus. Mechanized Information Center.
MECHANIZED INFORMATION CENTER Annual Report, 1 Feb. 1973 - 31 Jan. 1974
Bernard Bayer Dec. 1975 192 p
(Grant NSF GN-27458)
(PB-252855/2; MIC-AN-03) Avail: NTIS HC $7.50 CSCL 05B

In its third year of operation, the Mechanized Information Center (MIC) provided information services, primarily computer-based current awareness and retrospective searches, to 10,000 people. These services provided customized bibliographies from large data bases in the fields of science and engineering, social science, education, chemistry, agriculture, and psychology. As a

result, more than three million references to government reports, books, conference papers, and journal articles were generated. Each reference was on a separate card so that each person using the services could develop his or her own catalog of pertinent information. This third year of operation, which is described in detail has been a transition from the developmental first and second years to a fully operational fourth year. GRA

N76-33081# Institute of Public Administration, Washington, D.C.
OBSTACLES TO INNOVATION IN THE SCIENTIFIC AND TECHNICAL INFORMATION SERVICES INDUSTRY Final Report, 1 Aug. - Oct. 1975
Eldon Sweezy and Janice H. Hopper Oct. 1975 59 p
(Grant NSF GN-42300)
(PB-253449/3) Avail: NTIS HC $4.50 CSCL 05B

The efficiency and effectiveness of the scientific and technical information services serving the needs of the state and local public sector decision makers is evaluated with a view to enhancing service capabilities and improving state and local officials understanding of what is available and how it serves them. Questions addressed are: (1) how do scientific and technical information requirements in the public sector differ from the needs of commercial and corporate users; (2) do cost considerations affect public sector information users differently from private sector users; (3) how do information users and suppliers evaluate all of the separate factors in formulating their plans. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

N76-33082*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
COST BENEFIT ANALYSIS OF SPACE COMMUNICATIONS TECHNOLOGY: VOLUME 1: EXECUTIVE SUMMARY Technical Report, May 1975 - May 1976
L. D. Holland, P. G. Sassone, J. J. Gallagher, S. L. Robinette, F. H. Vogler, and R. P. Zimmer Aug. 1976 31 p ref 2 Vol.
(Contract NAS3-19700)
(NASA-CR-135060; A-1739-ES-Vol-1) Avail: NTIS HC $4.00 CSCL 05C

The questions of (1) whether or not NASA should support the further development of space communications technology, and, if so, (2) which technology's support should be given the highest priority are addressed. Insofar as the issues deal principally with resource allocation, an economics perspective is adopted. The resultant cost benefit methodology utilizes the net present value concept in three distinct analysis stages to evaluate and rank those technologies which pass a qualification test based upon probable (private sector) market failure. User-preference and technology state-of-the-art surveys were conducted (in 1975) to form a data base for the technology evaluation. The program encompassed near-future technologies in space communications earth stations and satellites, including the noncommunication subsystems of the satellite (station keeping, electrical power system, etc.). Results of the research program include confirmation of the applicability of the methodology as well as a list of space communications technologies ranked according to the estimated net present value of their support (development) by NASA. Author

N76-33083*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
COST BENEFIT ANALYSIS OF SPACE COMMUNICATIONS TECHNOLOGY. VOLUME 2: FINAL REPORT
L. D. Holland, P. G. Sassone, J. J. Gallagher, S. L. Robinette, F. H. Vogler, and R. P. Zimmer Aug. 1976 481 p refs 2 Vol.
(Contract NAS3-19700)
(NASA-CR-135061) Avail: NTIS HC $12.50 CSCL 05C
For abstract, see preceding accession.

N76-33084*# Old Dominion Univ., Norfolk, Va.
PLANNING AND EVALUATION PARAMETERS FOR OFFSHORE COMPLEXES
Michael Z. Sincoff, ed. and Jarir S. Dajani, ed. Langley Station, Va. NASA. Langley Research Center Sep. 1976 209 p refs Conf. held at Hampton, Va., 7 Jun. - 20 Aug. 1976
(Grant NGT-47-003-028)
(NASA-CR-145040) Avail: NTIS HC $7.75 CSCL 13M

Issues are presented for consideration in the planning and design of offshore artificial complexes. The construction of such complexes, their social, economic, and ecological impacts, and the legal-political-institutional environments within which their development could occur, are discussed. Planning, design, and construction of near-shore complexes located off the Mid-Atlantic coast of the United States is emphasized. Author

N76-33085*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MIUS COMMUNITY CONCEPTUAL DESIGN STUDY
Ben E. Fulbright Jun. 1976 565 p refs
(NASA-TM-X-58174; JSC-10650) Avail: NTIS HC $13.50 CSCL 05C

The feasibility, practicality, and applicability of the modular integrated utility systems (MIUS) concept to a satellite new-community development with a population of approximately 100,000 were analyzed. Two MIUS design options, the 29-MIUS-unit (option 1) and the 8-MIUS-unit (option 2) facilities were considered. Each resulted in considerable resource savings when compared to a conventional utility system. Economic analyses indicated that the total cash outlay and operations and maintenance costs for these two options were considerably less than for a conventional system. Computer analyses performed in support of this study provided corroborative data for the study group. An environmental impact assessment was performed to determine whether the MIUS meets or will meet necessary environmental standards. The MIUS can provide improved efficiency in the conservation of natural resources while not adversely affecting the physical environment. Author

N76-33086# Center for the Environment and Man, Inc., Hartford, Conn.
ANALYSIS OF THE FUTURE EFFECTS OF FUEL SHORTAGE AND INCREASED SMALL CAR USAGE UPON TRAFFIC DEATHS AND INJURIES Final Report, Jun. 1974 - Dec. 1975
Hans C. Joksch Jan. 1976 188 p refs
(Contract DOT-TSC-839)
(PB-251892/6; DOT-TSC-OST-75-21) Avail: NTIS HC $7.50 CSCL 13L

The Automotive Energy Efficiency Project is concerned with the examination of technological options for improving the fuel

efficiency of highway vehicles. This examination includes an analysis of the effects of existing and proposed mandated standards of fuel economy, safety and emissions on automobile design, estimation of the impacts of marketing and economic forces on automobile sales, and overall projections of fuel consumption for proposed automotive design alternatives. Also of interest are related effects on future air quality, highway safety, and on the costs of owning and operating automobiles. GRA

N76-33087# Center for the Environment and Man, Inc., Hartford, Conn.
ANALYSIS OF THE FUTURE EFFECTS OF FUEL SHORTAGE AND INCREASED SMALL CAR USAGE UPON TRAFFIC DEATHS AND INJURIES, EXECUTIVE SUMMARY Final Report, Jun. 1974 - Dec. 1975
Hans C. Joksch Jan. 1976 27 p refs
(Contract DOT-TSC-839)
(PB-251893/4; DOT-TSC-OST-75-21A) Avail: NTIS HC $4.00 CSCL 13L

The literature was reviewed and accident data were analyzed to establish relations between automobile size and the frequency of occupant death and injury. On the assumption of four future scenarios for the size of automobiles, the consequences for car occupant deaths were calculated. The present effects of the 55 mph speed limit and results that may be achieved by strict enforcement were estimated. The effects of the potential reduction of commuter traffic on vehicle deaths were estimated. The question of how the elimination of Sunday travel would affect motor vehicle deaths was addressed. GRA

N76-33088# Illinois Univ., Urbana-Champaign. Dept. of Civil Engineering.
URBAN STORMWATER RUNOFF: DETERMINATION OF VOLUMES AND FLOWRATES
Van Te Chow and Ben Chie Yen May 1976 255 p refs
(Contract EPA-68-03-0302)
(PB-253410/5; EPA-600/2-76-116) Avail: NTIS HC $9.00 CSCL 08H

An investigation is made to (a) develop a method of depth duration frequency analysis for precipitation events having short return period (high frequency) for urban storm water runoff management and control purposes; (b) develop a new high accuracy urban stormwater runoff determination method which when verified, can be used for projects requiring high accuracy detailed runoff results and can also be used as the calibration scale for the less accurate urban runoff prediction methods; and (c) compare and evaluate selected urban stormwater runoff prediction methods. Author (GRA)

N76-33089# Urban Inst., Washington, D.C.
GUIDELINES FOR THE ORGANIZATION OF COMMUTER VAN PROGRAMS Final Report
Gerald K. Miller and Melinda A. Green Feb. 1976 97 p refs
(PB-252305/8; UI-5050-2-5; UMTA-DC-06-0120-76-2) Avail: NTIS HC $5.00; HC also available in set of 2 reports as PB-252303-SET HC $8.00 CSCL 13B

The major stages are described in the development of a company sponsored commuter van program including: the investigation of program feasibility, the promotion and organization of the service, and the operation and administration of an ongoing operation. These guidelines are based on the experience of several successful programs and potential sponsors should find them useful for their particular situation. Seven detailed case studies which are representative of the major types of commuter van services are also presented. GRA

N76-33090# International Taxicab Association, Silver Spring, Md.
A COMPENDIUM OF PROVISIONS FOR A MODEL ORDINANCE FOR THE REGULATION OF PUBLIC PARA-TRANSIT
Robert E. Samuels Feb. 1976 236 p Sponsored by DOT
(PB-253182/0; UMTA-IL-06-0029-76-1) Avail: NTIS HC $8.00 CSCL 13B

A complete set of provisions for the regulation of various types of public para-transit transportation is presented. Topics discussed include: definitions; ambiguities; the licensing authority; operating licenses; vehicle licenses; chauffeur's and attendant's licenses; fees and penalties; financial responsibility; inspection of vehicles; books and records; reports; service of notice, etc.; hearings; affiliates; taxicabs; liveries and limousines; nontransit buses; jitneys; ambulances and cabulances; criminal offenses; police powers not infringed; amendments; and, partial invalidity. GRA

N76-33091# Transportation Research Board, Washington, D.C.
TRANSIT PLANNING
1976 140 p refs
(PB-252853/7; TRB/TRR-559) Avail: NTIS HC $10.00 CSCL 13B

Various aspects of transit planning and development are discussed. The application of demand responsive transportation systems, taxi systems, interactive systems, and various evaluation studies of transit are included. Author

N76-33092# Dayton Univ., Ohio. School of Engineering.
GRAVITY ASSISTED MASS TRANSIT
Arthur Z. Kovacs, George B. Shaw, Roger F. Weiss, and James K. Nelson, Jr. Jun. 1975 120 p refs
(PB-253416/2; UDSE-TR-75-02; UMTA-OH-11-0002; UMTA-OM-11-0002-75-1) Avail: NTIS HC $5.50 CSCL 13B

In fixed guideway transit with established station stops, the propulsion energy can be reduced by grading the guideway downward on leaving the station and grading upward on arrival at the next station. A computerized conceptual cost model was developed incorporating parameters relating to required elevated structures and required dynamical considerations. The increase in total cost required to construct a station stop at a given elevation above the guideway level between stops is calculated by the computer program to be compared with the resultant decrease in energy consumed in acceleration and deceleration. Because today's costs are extremely uncertain, unit costs are input by the user to determine the increased construction and operating costs and the resultant energy savings. The program outputs suggestions for structural design and associated cost data. GRA

N76-33093# City of Wichita Falls, Tex.
PROPERTY VALUATION AND EQUALIZATION SYSTEM PROVES APPLICATION COMPLETION REPORT
Apr. 1976 429 p
(Contract HUD-H-1217)
(PB-253398/2; USAC-WFT2-5017) Avail: NTIS HC $11.75 CSCL 13B

The objectives of the PROVES application include: providing the capability for equalizing property appraisals of all residential and commercial properties within the city of Wichita Falls and the Wichita Falls Independent School District; providing property information to other municipal departments as well as the property owner; and constructing an automated source for tax roll generation. This report documents the system procedures utilized to gather, store, update, and evaluate this property-related information. GRA

N76-33094# Urban Inst., Washington, D.C.
AN ANALYSIS OF COMMUTER VAN EXPERIENCE Final Report
Gerald K. Miller and Melinda A. Green Feb. 1976 41 p refs
(PB-252304/1; UI-5050-2-2; UTMA-DC-06-0120-76-1) Avail: NTIS HC $4.00; HC also available in set of 2 reports as PB-252303-SET, HC $8.00 CSCL 13B

The report analyzes the planning, organization, and operation of commuter van programs (often called van pools) in the U.S. and Canada. More than 30 existing operations were examined and classified by considering the major organizational arrangements for providing the service. The potential benefits van commuting generates for the users, employers and community are discussed, and the paper presents guidelines on the demand environment and indicates the service characteristics that are likely to be important in attracting riders. Major legal issues including public regulation competition with bus transit, liability and insurance, and implications of driver compensation are also reviewed. GRA

88 SPACE SCIENCES (GENERAL)

N76-33095# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR GEOPHYSICAL DATA NUMBER 378. PART 1: (PROMP REPORTS). DATA FOR JANUARY 1976 AND DECEMBER 1975. EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 366 (SUPPLEMENT) FEBRUARY 1975
Hope I. Leighton Feb. 1976 119 p
(PB-247137-378-1; SGD-378-Pt-1; NOAA-76031801-Pt-1)
Avail: NTIS MF $2.25; HC available from National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N.C. 28891. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue CSCL 03B

Predicted and observed solar and geophysical data for January 1976 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magnetic storms, and SID effects. Author

N76-33096# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 378 (SUPPLEMENT) EXPLANATION OF DATA REPORTS, FEBRUARY 1976
Feb. 1976 91 p
(PB-247137-378-S; SGD-378-Suppl; NOAA-76031803-Suppl)
Avail: NTIS MF $2.25; HC available from National Climatic Center. Attn: Publications. Federal Bldg., Asheville, N. C. 28891. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. This annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue CSCL 03B

This report contains the description and explanation of the data in the monthly publication, Solar-Geophysical Data. Also included is a complete index for data since July 1957. GRA

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N76-33097 Cornell Univ., Ithaca, N.Y.
FAR INFRARED SPECTROSCOPY OF H 2 REGIONS Ph.D. Thesis
Dennis Brien Ward 1976 111 p
Avail: Univ. Microfilms Order No. 76-21139

A fully liquid helium cooled grating spectrometer was developed for far infrared observations from the NASA Lear Jet. This instrument was used in observations of the galactic H 2 regions M42 and M17. The results of a search for the (O 3) 88.16 micron fine structure line are presented. The intensity of the line in M17 is reported, and an upper limit given for the intensity in M42. These results are compared with theoretical predictions, and future applications of infrared line observations are discussed. Coarse resolution spectra of M42 and M17 from 45 to 115 microns are also presented. The emission from M42 is shown to be a very smooth function of wavelength, closely fitting the wavelength dependence of a 105 K graybody. The spectrum of M17 shows a bump at approximately 75 microns and a general far infrared excess. The observed spectrum is compared to the predictions of models for M17. Dissert. Abstr.

N76-33098 Arizona Univ., Tucson.
THE MAGNETIC FIELD STRUCTURE AND EMBEDDED STELLAR POPULATION OF DARK CLOUD COMPLEXES Ph.D. Thesis
Frederick John Vrba 1976 185 p
Avail: Univ. Microfilms Order No. 76-21100

The magnetic field structures of the massive dark cloud complexes Rho Ophiuchi, R Corona Austrina, NGC 1333 and Lynds 1630 were mapped by means of visual, linear polarization measurements of background stars located at the periphery of the complexes. In addition, linear polarization measurements at a wavelength of 2.2 micrometers of stars embedded in the ophiuchi dark cloud established the magnetic field structure in the denser regions of that cloud. Because the cloud complexes are active regions of star formation, their evolution was examined in the context of mechanisms which may bring about gravitational collapse: shock wave compression, Parker instability accretion, cloud-cloud collisions, and quiescent collapse. It appears that magnetic fields are significant in controlling the evolution of the clouds. The central regions of each of the clouds were also mapped at a wavelength of 2.2 micrometers in order to investigate the structure of possible embedded clusters of stars and to compare the star formation efficiencies. Author

N76-33099 California Univ., San Diego.
DIGICON SPECTROPHOTOMETRY OF THE LAMBDA ORIONS HII REGION Ph.D. Thesis
Richard James Harms 1976 78 p
Avail: Univ. Microfilms Order No. 76-20322

Spectrophotometry of several nebular surface areas in the Lambda Orionis HII region, obtained using a 212-channel digicon, determines the ionization structure and morphology of this nebula. The ionization structure of the surrounding nebulae indirectly measures the stellar photon flux in portions of the far ultraviolet spectrum of the exciting star Lambda Ori A, revealing the existence of significant spectral discontinuities produced by metallic-ion opacities in the stellar atmosphere. For this HII region, the altered ionization structure due to stellar metal opacities causes the region in which nitrogen is predominantly doubly ionized to extend beyond that in which oxygen is mostly doubly ionized. Whether such altered ionization structures can lead to systematic errors in derived nitrogen-to-oxygen abundance gradients across spiral galaxies inferred from observations of extragalactic HII regions is considered. Dissert. Abstr.

N76-33100*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NATURAL ENVIRONMENT DESIGN REQUIREMENTS FOR THE SPACE TELESCOPE (REVISION A)
George S. West and Jerry J. Wright Sep. 1976 7 p refs Supersedes NASA-TM-X-73316
(NASA-TM-X-73331) Avail: NTIS HC $3.50 CSCL 14B

The natural environment design requirements for the Space Telescope are presented. Because the Space Telescope is to be carried as cargo to orbital altitudes in the space shuttle bay, orbital environment impacts are the main concern. Author

N76-33101*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE TELESCOPE COORDINATE SYSTEMS, SYMBOLS, AND NOMENCLATURE DEFINITIONS
Hans F. Kennel Sep. 1976 36 p
(NASA-TM-X-73343) Avail: NTIS HC $4.00 CSCL 20F

The major coordinate systems as well as the transformations and transformation angles between them, for the Space Telescope are defined. The coordinate systems were primarily developed for use in pointing and control system analysis and simulation. Additional useful information (on nomenclature, symbols, quaternion operations, etc.) is also contained. Author

N76-33102*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ALL-SKY MONITOR OBSERVATIONS OF FLARES FROM AQUILA X-1
L. J. Kaluzienski, S. S. Holt, E. A. Boldt, and P. J. Serlemitsos Oct. 1976 14 p refs Submitted for publication
(Grant NGR-21-002-316)
(NASA-TM-X-71202; X-661-76-218) Avail: NTIS HC $3.50 CSCL 03A

The All-Sky Monitor on Ariel 5 has observed the Aquila-Serpens region on a quasi-continuous basis since launch in 1974 October. During this time Aql X-1 exhibited major flares in 1975 June and 1976 June, with the measured X-ray intensities increasing more than an order of magnitude to approximately that measured from the Crab nebula, and remaining above the

experiment threshold (approximately 0.1 x s crab) for almost two months in both instances. These outbursts resemble the X-ray light curves of transient sources such as A0620-00 and are interpreted in terms of episodic accretion in a dwarf nova-like binary. Combination of the epoch of phase minimum for the 1.3d period (1976) with the 1975 data yields a value of P = 1.28d + or - 0.02d with a corresponding modulation of approximately 3% (3-6 keV). Modulation at this period is not apparent in the 1976 data, with an upper limit of 2% during that time. Author

N76-33103# National Bureau of Standards, Washington, D.C.
REPORTS OF OBSERVATORIES FOR 1974/1975 NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. Interim Report, Sep. 1974 - Sep. 1975
Lucy Hagan Sep. 1975 6 p refs Repr. from Bull. Am. Astrom. Soc., v. 8, No. 1, 1976 p 210-214
(PB-252789/3) Avail: NTIS HC $3.50 CSCL 03B

Research at the National Bureau of Standards in spectroscopy pertinent to astronomy is summarized. Publications on atomic spectra, atomic transition probabilities and line broadening, and molecular spectra are referenced and work in progress is discussed. GRA

N76-33104# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
ASTRONOMICAL IMAGE RECONSTRUCTION Instrumentation Papers
Simon P. Worden 12 Dec. 1975 28 p refs
(AF Proj. 7649)
(AD-A022624; AFCRL-IP-244; AFCRL-TR-75-0630) Avail: NTIS CSCL 20/6

Recently proposed methods for reconstructing large telescope astronomical images free from atmospheric perturbation are reviewed and discussed. Author (GRA)

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N76-33105 California Univ., Los Angeles.
A GENERAL PERTURBATION METHOD AND ITS APPLICATION TO THE MOTIONS OF THE FOUR MASSIVE SATELLITES OF JUPITER Ph.D. Thesis
Chia-chun Chao 1976 149 p
Avail: Univ. Microfilms Order No. 76-20193

A general perturbation method based on the concept of perturbed variations and the concept of intermediate reference orbit was developed with the help of a computerized series expansion technique for the study of the motions of the massive satellites of the outer planets. Methods of obtaining variations of orbit elements based on the disturbing function approach and the force components approach were compared. The force components approach which directly relates the variations to the perturbing forces was used. The variations were obtained in a particular set of elements suited for small eccentricities and inclinations. The Newton iteration method was applied for the expansion of 1/Delta with the computerized series expansion technique. A 6+6 system of computerized series expansion and integration program was developed for the purpose of this study. The method was then applied to the motions of the four massive satellites of Jupiter. Dissert. Abstr.

N76-33106 Arizona Univ., Tucson.
THE DEPENDENCE OF THEORETICAL BINARY STAR MASS TRANSFER RATES ON THE ASSUMPTION OF SYNCHRONOUS ROTATION Ph.D. Thesis
John Paul Pratt 1976 93 p
Avail: Univ. Microfilms Order No. 76-21101

It was shown that, if the usual assumption of synchronous rotation (infinitely effective tidal coupling) in semi-detached binary systems is replaced by that of detailed conservation of angular momentum with negligible tidal torques, the system can be predicted to evolve in a qualitatively different manner after the onset of mass loss. For a wide range of mass ratios, initial mass transfer proceeds on a nuclear rather than a Kelvin time scale and can last for an appreciable fraction of the main sequence lifetime. It is suggested that the actual evolution of the system is determined by the time scale of tidal interaction and that the mass transfer rate probably lies between the classical values and those found here. Possible implications of the present results for X-ray sources such as HZ Her are discussed briefly. Dissert. Abstr.

N76-33107 California Inst. of Tech., Pasadena.
SEMICONVECTION IN HALO STARS AND THE PRIMORDIAL HELIUM ABUNDANCE Ph.D. Thesis
Theodore Dean Tarbell 1976 196 p
Avail: Univ. Microfilms Order No. 76-19581

Convective overshooting and semiconvection in core-helium burning stars are studied. A necessary condition for the onset of semiconvection is derived, and the Schwarzschild neutrality criterion for the semiconvective zone is justified. Evolutionary sequences for horizontal branch stars in the globular cluster M3 are computed. They illustrate the effects of different treatments of overshooting and semiconvection, helium-burning nuclear reaction rates, and the primordial helium abundance. Evolutionary models for subdwarf B stars are computed which show excellent agreement with observed gravities and effective temperatures. These models are burning helium at their centers with thin, inert hydrogen envelopes. The hypothesis of mass loss at the helium flash can explain the small envelope masses and the observed gaps in the color distribution of blue halo stars. An upper limit to the initial helium abundance of sdB stars is derived from their light-to-mass ratios. Dissert. Abstr.

N76-33108 California Inst. of Tech., Pasadena.
BRIGHTNESS DISTRIBUTIONS IN COMPACT AND NORMAL GALAXIES Ph.D. Thesis
John Kormendy 1976 203 p
Avail: Univ. Microfilms Order No. 76-20430

A study was made of three problems on luminosity distributions in galaxies: the nature of red compact galaxies, the systematic properties of spheroids, and the effect of decomposing observed profiles into spheroid and disk components. Photographic brightness profiles were measured for sixteen compact and four normal galaxies. A systematic study of galaxy spheroids was also made by fitting the de Vaucouleurs r to the 1/4 power-law to the profiles of sixteen compact and nineteen normal galaxies. Finally, exponential disk parameters were derived for seven S0 compacts and for NGC 7457. Dissert. Abstr.

N76-33109 California Inst. of Tech., Pasadena.
THE STRUCTURE OF CLUSTERS OF GALAXIES AND THE ANGULAR SIZE-REDSHIFT TEST Ph.D. Thesis
Paul Hickson 1976 87 p
Avail: Univ. Microfilms Order No. 76-19576

An angular size-redshift cosmological test is presented based on the projected separations between bright cluster galaxies as the size statistic. The method is applied to 95 clusters of galaxies with redshifts ranging from .02 to .46 yielding a value of the deceleration parameter before evolution of q sub 0 = -.9. After correcting for known evolutionary effects q sub 0 = -.8 is obtained. The formal standard deviation in q sub 0 at these values is .2, which corresponds to an uncertainty of about .4 at q sub 0 = 0. It is argued that the selection criteria for the sample, and the observed behavior of the cluster size dispersion with redshift precludes the existence of any major selection or evolutionary effects in the data. Structure parameters are presented for a sample of 64 cosmologically near clusters. New type classifications are presented for 23 clusters. Mean surface density profiles are determined for the various cluster types. It is found that many clusters are deficient in separations of one to two Mpc. Dissert. Abstr.

N76-33110 Washington Univ., Seattle.
THE METAL ABUNDANCE OF POPULATION 2 SYSTEMS OF THE GALAXY Ph.D. Thesis
Ronald William Canterna 1976 220 p
Avail: Univ. Microfilms Order No. 76-20710

A new broad-band photometric system, C, M, T sub 1, T sub 2, was developed to obtain accurate temperatures and abundance parameters for G and K giants. The calibration of the system

was determined from observations of G and K stars. Theoretical model atmosphere colors were also computed and used to calibrate the C, M, T sub 1, T sub 2, system for stars with 4,000 K > T sub eff < 8,000 K, -5.0 > M sub v > 3.0, and 1.0Z sub 0 > Z > .001Z sub 0. Individual giants in several globular clusters and Draco were observed. Draco was found to be metal poorer than M 92. NGC 4147 was found to be either CN enriched or slightly older than M 92. Dissert. Abstr.

N76-33111 California Univ., San Diego.
TOPICS IN ASTROPHYSICS AND MANY-BODY THEORY Ph.D. Thesis
Legesse Senbetu 1976 95 p
Avail: Univ. Microfilms Order No. 76-20333

Beta decay formulas in astrophysical and superheavy element applications are first discussed. A new formula is presented which predicts decay rates that increase more strongly with energy than do conventional extrapolations in the neutron-rich superheavy element region. Sound waves near T sub c in a dynamic spherical model are then considered. The propagation of sound waves and heat diffusion near the critical point in a n/2-component complex spin model in the limit of large n is studied. Finally, the effect of He-3 impurities on the properties of quantized vortex lines is discussed. At very low temperatures He-3 atoms condense onto vortex cores resulting in phase separation. The normal He-3 rich fluid occupies the central core region, the radius of which is determined as a function of temperature and He-3 concentration. Calculations show that the lifetime of electrons trapped on vortex lines decreases below approximately 0.6 K, increases rapidly near 0.3 K, and is almost zero between 0.3 and 0.45 K. Dissert. Abstr.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N76-33112*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
ANALYSIS OF LEAM EXPERIMENT RESPONSE TO CHARGED PARTICLES Final Report
D. Perkins 4 Oct. 1976 142 p
(Contract NAS9-14751)
(NASA-CR-147872; BSR-4234) Avail: NTIS HC $6.00 CSCL 03B

The objectives of the Lunar Ejecta and Meteorites Experiment (LEAM) were to measure the long-term variations in cosmic dust influx rates and the extent and nature of the lunar ejecta. While analyzing these characteristics in the data, it was discovered that a majority of the events could not be associated with hypervelocity particle impacts of the type usually identified with cosmic dust, but could only be correlated with the lunar surface and local sun angle. The possibility that charged particles could be incident on the sensors led to an analysis of the electronics to determine if such signals could cause the large pulse height analysis (PHA) signals. A qualitative analysis of the PHA circuit showed that an alternative mode of operation existed if the input signal were composed of pulses with pulse durations very long compared to the durations for which it was designed. This alternative mode would give large PHA outputs even though the actual input amplitudes were small. This revelation led to the examination of the sensor and its response to charged particles to determine the type of signals that could be expected. Author

N76-33113*# Scientific Translation Service, Santa Barbara, Calif.
A DISSERTATION ON AEROLITES CAST DOWN FROM THE MOON
A. Agardh and H. Schartau Washington NASA Jul. 1976 11 p refs Transl. into ENGLISH of "De Aerolithis ex Luna Dejectis" Dissertation, Carolina Academy. Lund, Sweden, Berlinianis Press, 17 Dec. 1808 p 1-14
(Contract NASw-2791)
(NASA-TT-F-17115) Avail: NTIS HC $3.50 CSCL 03B

The opinions held by different scientists regarding the origin of aerolites are discussed. The authors calculate the altitude at which the attraction of the Moon and the Earth are equal. Author

N76-33114*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE WAVELENGTH DEPENDENCE AND AN INTERPRETATION OF THE PHOTOMETRIC PARAMETERS OF MARS
W. R. Weaver and W. E. Meador Sep. 1976 28 p refs
(NASA-TM-X-73937) Avail: NTIS HC $4.00 CSCL 03B

The photometric function developed by Meador and Weaver has been used with photometric data from the bright desert areas of Mars to determine the wavelength dependence of the three photometric parameters of that function and to provide some predictions about the physical properties of the surface. Knowledge of the parameters permits the brightness of these areas of Mars to be determined for scattering geometry over the wavelength range of 0.45 to 0.70 micrometer. The changes in the photometric parameters with wavelength are shown to be consistent with qualitative theoretical predictions, and the predictions of surface properties are shown to be consistent with conditions that might exist in these regions of Mars. The photometric function is shown to have good potential as a diagnostic tool for the determination of surface properties, and the consistency of the behavior of the photometric parameters is shown to be good support for the validity of the photometric function. Author

N76-33115*# Marine Science Inst., Galveston, Tex.
LUNAR SEISMIC PROFILING EXPERIMENT NATURAL ACTIVITY STUDY Final Report
F. K. Duennebier 14 Sep. 1976 46 p refs
(Contract NAS9-14405)
(NASA-CR-150987) Avail: NTIS HC $4.00 CSCL 03B

The Lunar Seismic Experiment Natural Activity Study has provided a unique opportunity to study the high frequency (4-20 Hz) portion to the seismic spectrum on the moon. The data obtained from the LSPE was studied to evaluate the origin and importance of the process that generates thermal moonquakes and the characteristics of the seismic scattering zone at the lunar surface. The detection of thermal moonquakes by the LSPE array made it possible to locate the sources of many events and determine that they are definitely not generated by astronaut activities but are the result of a natural process on the moon. The propagation of seismic waves in the near-surface layers was studied in a qualitative manner. In the absence of an adequate theoretical model for the propagation of seismic waves in the moon, it is not possible to assign a depth for the scattering layer. The LSPE data does define several parameters which must be satisfied by any model developed in the future. Author

N76-33116*# Lamont-Doherty Geological Observatory, Palisades, N.Y.
LUNAR HEAT-FLOW EXPERIMENT: LONG TERM TEMPERATURE OBSERVATIONS ON THE LUNAR SURFACE AT APOLLO SITES 15 AND 17
Kenneth Peters Oct. 1975 35 p refs
(Contract NAS9-6037)
(NASA-CR-150956; TR-3-CU-3-75) Avail: NTIS HC $4.00 CSCL 03B

Several investigators of the Apollo lunar experiments have observed gradual increases in the mean temperatures recorded by various surface thermometers. Similar effects were noticed in the temperatures of the thermometers of the Apollo 15 and 17 Heat Flow Experiments. An analysis of the long term temperature histories of the heat flow experiment thermometers is presented. These data show that no change in mean surface temperature at the Apollo 15 and 17 sites has occurred, and suggest that the slow increase in mean temperatures of thermometers in the electronics housing are due to changes in radiative properties of the housing's surfaces. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

No abstracts in this category.

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N76-33117*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY LINES FROM INTERSTELLAR GRAINS
R. E. Lingenfelter (Calif. Univ., Los Angeles) and R. Ramaty Aug. 1976 15 p refs
(Grant NSF AST-67-08178)
(NASA-TM-X-71191; X-660-76-184) Avail: NTIS HC $3.50 CSCL 03B

The existence of very narrow (FWHM < or approximately = 5 KeV) gamma ray line emission from interstellar grains is pointed out. The prime candidate for detection is the line at 6.129 Mev from O-16, but other very narrow lines could also be detected at 0.847, 1.369, 1.634, 1.779 and 2.313 Mev from Fe-56, Mg-24, Ne-20, Si-28 and N-14. Measurements of this line emission can provide information on the composition, size and spatial distribution of interstellar grains. Author

N76-33118*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PARTIALLY AVERAGED FIELD APPROACH TO COSMIC RAY DIFFUSION
Frank C. Jones, Thomas J. Birmingham, and Thomas B. Kaiser Aug. 1976 57 p refs
(NASA-TM-X-71193; X-602-76-175) Avail: NTIS HC $4.50 CSCL 03B

The kinetic equation for particles interacting with turbulent fluctuations is derived by a new nonlinear technique which successfully corrects the difficulties associated with quasilinear theory. In this new method the effects of the fluctuations are evaluated along particle orbits which themselves include the effects of a statistically averaged subset of the possible configurations of the turbulence. The new method is illustrated by calculating the pitch angle diffusion coefficient D sub Mu Mu for particles interacting with slab model magnetic turbulence, i.e., magnetic fluctuations linearly polarized transverse to a mean magnetic field. Results are compared with those of quasilinear theory and also with those of Monte Carlo calculations. The major effect of the nonlinear treatment in this illustration is the determination of D sub Mu Mu in the vicinity of 90 deg pitch angles where quasilinear theory breaks down. The spatial diffusion coefficient parallel to a mean magnetic field is evaluated using D sub Mu Mu as calculated by this technique. It is argued that the partially averaged field method is not limited to small amplitude fluctuating fields and is hence not a perturbation theory. Author

N76-33119*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRAL EVOLUTION OF A LONG X-RAY BURST
J. H. Swank, R. H. Becker, E. A. Boldt, S. S. Holt, S. H. Pravdo, and P. J. Serlemitsos Sep. 1976 15 p refs Submitted for publication
(Grant NGR-21-002-316)
(NASA-TM-X-71195; X-661-76-206) Avail: NTIS HC $3.50 CSCL 03B

An X-ray burst-like event with a peak intensity 1 1/2 times that of the Crab and a decay time of approximately 100s was observed. Significant spectral changes occurred during the burst. The spectra were best fit by the black form with kT ranging from .87 keV to 2.3 keV. They suggest a source with smaller dimensions than a massive black hole. A weak source was observed after the burst with a 10 keV thermal spectrum and an indication of iron line emission. Author

N76-33120*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY ANALYSIS OF THE IMPLICATIONS OF NATURAL RADIATIONS ON GEOSTATIONARY OPERATIONS
John W. Wilson and Fred M. Denn (Old Dominion Univ., Norfolk, Va.) Washington Sep. 1976 60 p refs Sponsored in part by Old Dominion Univ.
(NASA-TN-D-8290; L-10951) Avail: NTIS HC $4.50 CSCL 03B

The natural radiations present at geostationary orbit are discussed. Low-level galactic cosmic rays are important for careers spending a year or more at geostationary altitude. Trapped radiation will on occasion require interruption of extravehicular activity (EVA). The spacesuit shield requirements are strongly affected by the number of interruptions allowed. EVA cannot proceed during a large solar event and maximum allowable doses are exceeded in a few hours unless a heavily shielded area is provided. A shelter of 10 g/sq cm with personal shielding for the eyes and testes would contain exposure to within the presently accepted exposure constraints. Since radiation levels can increase unexpectedly to serious levels, an onboard radiation monitoring system with rate and integration capabilities is required for both surface-dose and depth-dose monitoring. Author

N76-33121*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF THIN IONIZATION CALORIMETERS FOR MEASUREMENTS OF COSMIC RAY ENERGY SPECTRA
W. V. Jones, J. S. Ormes, and W. K. H. Schmidt Sep. 1976 40 p refs Submitted for publication
(NASA-TM-X-71198; X-661-76-221) Avail: NTIS HC $4.00 CSCL 03C

The reliability of performing measurements of cosmic ray energy spectra with a thin ionization calorimeter was investigated. Monte Carlo simulations were used to determine whether energy response fluctuations would cause measured spectra to be different from the primary spectra. First, Gaussian distributions were assumed for the calorimeter energy resolutions. The second method employed a detailed Monte Carlo simulation of cascades from an isotropic flux of protons. The results show that as long as the energy resolution does not change significantly with energy, the spectral indices can be reliably determined even for sigma sub e/e = 50%. However, if the energy resolution is strongly energy dependent, the measured spectra do not reproduce the true spectra. Energy resolutions greatly improving with energy result in measured spectra that are too steep, while resolutions getting much worse with energy cause the measured spectra to be too flat. Author

N76-33122*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATION OF GAMMA RAYS WITH A 4.8 HOUR PERIODICITY FROM CYG X-3
R. C. Lamb, C. E. Fichtel, R. C. Hartman, D. A. Kniffen, and D. J. Thompson Sep. 1976 14 p refs Submitted for publication
(NASA-TM-X-71201; X-662-76-204) Avail: NTIS HC $3.50 CSCL 03C

Energetic (E>35 MeV) Gamma rays were observed from Cyg X-3 with the SAS-2 Gamma ray telescope. They are modulated at the 4.8 sup h period observed in the X-ray and infrared regions, and within the statistical error are in phase with this emission. The flux above 100 MeV has an average value of (4.4 + or - 1.1)x 10 to the -6 power/sq cm/sec. If the distance to Cyg X-3 is 10 kpcs, this flux implies a luminosity of more than 10 to the 37th power ergs/s if the radiation is isotropic and about 10 to the 36th power ergs/s if the radiation is restricted to a cone of one steradian, as it might be in a pulsar. Author

99 GENERAL

N76-33123* + National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AMES RESEARCH CENTER PUBLICATIONS, 1974
Sep. 1976 141 p
(NASA-TM-X-73167; A-6729) Avail: NTIS HC $6.00 CSCL 05B

A bibliography is presented of the publications of Ames Research Center authors and contractors which appeared in formal NASA publications, journal articles, books, chapters of books, patents, and contractor reports. Author

N76-33124* + Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY: JANUARY - DECEMBER 1975
15 Sep. 1976 160 p refs
(Contract NAS7-100)
(NASA-CR-148808; JPL-Bibl-39-17) Avail: NTIS HC $6.75 CSCL 05B

A bibliography describing and indexing the formal technical reports released between January and December 1975 that resulted from scientific and engineering work was presented. Five classes of publications are included: technical reports, technical memoranda, articles from the bimonthly Deep Space Network (DSN) Progress Report, special publications, and articles published in the open literature. The publications are indexed by author, subject, and publication type and number. Author

N76-33125# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 APRIL - 30 JUNE 1976
Jun. 1976 76 p refs
(DME/NAE-1976(2); ISSN-0047-9055) Avail: NTIS HC $5.00

Papers are presented dealing with computer modeling and psychomotor test performance of flight crews. For individual titles, see N76-33126 through N76-33127.

N76-33126 National Research Council of Canada, Ottawa (Ontario). Division of Mechanical Engineering.
COMPUTER MODELING AND SIMULATION HANDBOOK **c60**
R. E. Gagne *In its* Quarterly Bull. of the Div. of Mech. Engr. and the Natl. Aeron. Estab. Jun. 1976 p 1-17 refs Repr. from Simulation, vol. 26, no. 6, May 1976 p 147-161 (For availability see N76-33125 23-99)

The design of a computer model is seen as a procedure encompassing five stages. These include: the definition phase, design phase, programming verification and validation phase, operational phase, and wrapup phase. These steps are briefly discussed and system model examples are given. The advantages of modular program structures are also discussed. J.M.S.

N76-33127 National Research Council of Canada, Ottawa (Ontario). Division of Mechanical Engineering.
PSYCHOMOTOR TEST PERFORMANCE AND SLEEP PATTERNS OF AIRCREW FLYING TRANSMERIDIONAL ROUTES **c52**
Leslie Buck *In its* Quarterly Bull. of the Div. of Mech. Engr. and the Natl. Aeron. Estab. Jun. 1976 p 19-33 refs (For availability see N76-33125 23-99)

Pilots and flight attendants flying scheduled services between Vancouver and Tokyo and between Toronto and Rome were tested on a tracking task before and after flights in each direction. Flights were included in schedules involving both 24-hour and 7-day layovers at the overseas station. During these periods they recorded their sleep patterns. The data showed that the flight subjects made an immediate attempt to adapt their behavior to local time and that changes in their performance scores could be interpreted on that basis. It was concluded that behavioral circadian rhythms adapt rapidly to a new time zone. Author